



PHD

## Capability, Governance and Collaboration: Understanding the Supplier Perspective

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**Capability, Governance and Collaboration:  
Understanding the supplier perspective**

**NIRAJ KUMAR**

A thesis submitted for the degree of  
Doctor of Philosophy  
University of Bath  
School of Management

**August 2012**

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*Dedicated to,*  
*my beloved sister, **Saumya Rani** (1985 - 2008)*  
*and*  
*my grandfather, **Ram Prasad Singh** (1922 - 2010).*  
*You will forever remain in my thoughts and prayers.*

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## ABSTRACT

This research investigates the relationship between supplier capabilities, inter-firm governance and buyer-supplier collaboration. The research focuses on three functional capabilities (Research and Development (R&D), Production and Support services capability), two governance mechanisms (Contractual and Relational governance) and three types of buyer-supplier collaboration (Information sharing, Collaborative product/service development and Collaborative problem solving). A theoretical framework is developed which first examines the multiple mediation effect of contractual and relational governance on the relationship between capability and collaboration type, and second, explores the relative strength of the indirect effect through contractual and relational governance.

Survey based research methodology is used to empirically test the hypotheses in this research. Data are collected from a total of 120 SMEs in the UK aerospace industry. Bootstrapping based techniques are used to analyse the data and to examine the proposed relationship between capability, governance and collaboration. The empirical findings indicate that although both contractual and relational governance are important in order to link the supplier capability with collaboration, the individual effect of contractual and relational governance varies in different combinations of capabilities and collaboration types.

The potential contribution of this research is twofold: *first*, in terms of academic contribution, this study combines the arguments of Resource Based View and Transaction Cost Economics to provide a holistic view in explaining the inter-relation between capability, governance and buyer-supplier collaboration; *Second*, in terms of practical contribution, this study improves the understanding of practitioners in both buying and supplying firm regarding the alignment of inter-firm exchange processes with capabilities to achieve better performance in collaboration.

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## **LIST OF ABBREVIATIONS**

AeIGT	Aerospace Innovation and Growth Team
BC	Bias Corrected
BSC	Buyer Supplier Collaboration
c	Total effect of independent variable on dependent variable
c'	Direct effect of independent variable on dependent variable
CFA	Confirmatory Factor Analysis
CI	Confidence Interval
CPD	Collaborative Product/Service Development
CPS	Collaborative Problem Solving
DV	Dependent Variable
EFA	Exploratory Factor Analysis
EM	Expectation Maximization
IPR	Intellectual Property Rights
IS	Information Sharing
IV	Independent Variable
KMO	Kaiser-Meyer-Olkin measure
MAR	Missing at Random
MCAR	Missing Completely at Random
ML	Maximum Likelihood
NMAR	Not Missing at Random
p	Significance Level
PASW	Predictive Analytics Software
PCA	Principal Component Analysis
r	Pearson Correlation Coefficient
RBV	Resource Based View
R&D	Research and Development
SC	Supply Chain
SCM	Supply Chain Management
SC21	21st Century Supply Chain
SME	Small to Medium Enterprise
SPSS	Statistical Package for the Social Sciences
TCE	Transaction Cost Economics
WEAF	West of England Aerospace Forum

# **CHAPTER 1**

## **INTRODUCTION**

### **1.1 Introduction**

In an increased competitive environment across the globe, the importance of buyer – supplier collaboration in the supply chain is realised to generate sources of sustainable competitive advantage. For the past 20 years, studies related to buyer-supplier collaboration have gained significant attention of academicians and practitioners (Nobbs 2008). Buyer – supplier collaboration involves the interaction between buyer and supplier in a supply chain to share both tangible (machines, staff etc.) and intangible (knowledge, information, skills etc.) resources across firm boundaries to maximise value for the customer (Wood and Gray 1991, Kanter 1994, Powell et al. 1996). Collaboration provides the opportunity to leverage a firm's strength with the help of partnering firms and to spread the risks related to capital investment, costs of innovation and shrinking product lifecycles (Inkpen 2000, Mowery et al. 1996). It is commonly held that inter-firm exchanges across firm boundary entail both contractual and relational form of governance mechanism (Anand and Khanna 2000, Luo 2002, Zhang et al. 2003). Although formal agreement provides safeguards against inappropriate or opportunistic behaviour in collaboration, buyers and suppliers are increasingly involved in trust building activities to achieve greater benefit from collaboration, and to avoid the risk of opportunistic behaviour due to future uncertainties (Zaheer and Venkataraman 1995, Kale et al. 2000).

In the current business environment of increased uncertainty and competition, firms seldom survive and prosper solely through their individual efforts alone. As a result, firms increasingly promote collaboration in supply chain. Collaboration however does not merely involve the development, communication and reinforcement of shared goals and objectives, but also emphasize the alignment of the capability with the particular form of transaction process to facilitate knowledge exchange and information sharing. Each firm's performance in collaboration depends upon the nature and quality of the direct and indirect relationships a firm develops with its SC partner (Wilkinson and Young 2002).



While focus on core capabilities is necessary, firms also need to look into the inter-firm transaction process before engaging in collaborative activities. This is particularly important in order to effectively gain access to complimentary skills or resources of the partnering firm or developing combinative capabilities. This study focuses on the dyadic collaborative arrangement between buyer and supplier, and asks; which form of inter-firm governance mechanism (contractual, relational or both) would be appropriate for suppliers in managing the buyer – supplier collaboration effectively, especially in view of the capabilities they possess? Contractual governance typically relies more on the written formal agreement, whereas relational governance promotes transactions based on mutual trust and inter-firm relations.

Collaboration promotes working together with the aim to maintain a win-win situation for both buyer and supplier. Yet, initiating, maintaining and growing the collaborative relationship are cumbersome. Nobbs (2008) argues that the whole process of collaboration is more complex than it appears. In the process of addressing this complexity, firms need to identify first its core capabilities and then decide on the transaction process with an idea of the risks involved in collaboration and the extent to which firms want to engage in resource sharing. Misalignment of capability and inter-firm governance results in ineffective management of collaboration and thus affects the collaboration performance (Hamel et al. 1989). Oh and Rhee (2008) argue that limited attempts are made in management literatures to understand the interaction between supplier capability and different types of buyer-supplier collaboration. In this context the Resource Based View (RBV) (Barney 1986, 1991, Priem and Butler 2001) of the firm is key, which stresses the importance of firm specific capabilities to generate sources of sustainable competitive advantage. RBV is particularly useful in understanding the supplier's capability perspective in terms of accessing the buyer-supplier collaborative relationships.

Mayer and Salomon (2006) argue that although RBV provides insights into the capabilities, which can generate value, little attention has been devoted to understand how capabilities impact on governance. They further suggest that supplier capability plays an important role in governance decision-making.

Although firm heterogeneity does not explicitly enter transaction costs logic, literature by Argyres (1996), Leiblein and Miller (2003), Mayer (2006), Nickerson and Silverman (2003), Nickerson and Zenger (2002) and Silverman (1999) has emerged which explores the potential for the firm's capabilities to influence governance structure. Williamson (1999) also considers that more research is needed to explore the relation between firm's existing capabilities and how this influences governance structure. This study therefore investigates the role of contractual and relational governance on the relationship between supplier capabilities and type of buyer-supplier collaboration.

This chapter introduces the fundamental concepts of the research and sets the structure of the study. The remainder of the chapter is organised as follows; *Section 1.2* describes the problem statement in context of the aerospace industry, *Section 1.3* discusses the academic and practical significance, and the motivation for this research. Consequently, *Section 1.4* describes the aims and objectives of this research and finally, *Section 1.5* presents the structure of the transfer document.

## **1.2 Research motivation**

Although, buyer-supplier collaboration is important for the success of the supply chain, supplier specific capabilities, which manage collaboration, are crucial (Oh and Rhee 2008). The aerospace industry has experienced an intense competition and rapid technological changes in the past decade. As a result, buyer-supplier interdependency has increased, which demands the supplier's active involvement to add value to final products and services. Recently a nationwide collaborative action plan for 21<sup>st</sup> Century Supply Chains (SC21) is developed to promote collaboration in aerospace and defence supply chains in the UK to tackle threats of global competition (SBAC 2008). Major aerospace companies like Airbus, GE aviation, BAE systems, Rolls-Royce etc., and the UK Ministry of Defence have committed to follow the guidelines of SC21 to improve efficiency and lower overheads in the supply chain. The SC21 programme stresses more on the importance of supplier capability and relationship with the buyer to enhance the performance of the supply chain. It promotes a collaborative business culture built through open and transparent communication among supply chain partners. While past studies (Nobbs 2008) have showed the long-term benefits of buyer-supplier cooperation,

there is a lack of clarity in current business practice over the impact of contractual agreement and mutual relationship on the collaborative performance in the supply chain. This study recognises the value of initiatives such as SC21 (e.g. supply chain beyond prime or engaging suppliers), and explores how supplier capabilities are linked with different types of collaboration in the UK aerospace industry.

The UK aerospace industry is largest in the world outside USA (SBAC 2008). The accelerating technological change and growing international competition have realised the potential benefits of the greater degree of collaboration between aerospace firms. Bennett (1997) argues that collaborative partnerships in aerospace ranges from formal to the informal. In this context the author discusses a range of benefits of collaboration such as mutual learning, reduced risk of uncertainty, speedy delivery to the customer and survival in the competitive business environment. In a capital-intensive industry such as aerospace where the demand uncertainty is less likely to occur, the vertical integration effect can help in performance efficiency. While the need of collaboration and its potential benefits are apparent, there is a lack of clarity in current business practice over how the market uncertainty affects the relation between supplier capability and collaboration. There is a growing recognition that companies no longer compete as single entities, and works as a part of the SC to deliver value to the customer. Crute et al. (2008) argue that the need for greater collaboration in the aerospace supply chain is evident from a number of sources. However, they also identify the need for more research in exploring the SC collaboration in aerospace industry. The boundary of the firm is becoming more permeable to provide an opportunity for greater degree of collaboration in this industry. Furthermore, Smith (2003) discusses that strategic alliances are an important feature of aerospace industry and more studies are sought to evaluate their performance. While it is apparent that collaboration between buyer and supplier is crucial for future success in the industry, the capability-based perspective of collaboration from supplier point of view is also important in understanding the dynamics of buyer-supplier collaboration ('BSC') in terms of challenges and threats.

The UK government sponsored Aerospace Innovation and Growth Team (AeIGT 2003) reports that the firm-level thinking in the aerospace industry has shifted from

an individual company focus to a multi-company perspective. It is argued that the growing expectation of high performance at low cost cannot be achieved and sustained by simply focusing on an individual company in isolation. The competitive business environment is driving ever-increasing interest in different forms of collaborations and business partnerships (e.g. Sako 1990, Lamming 1993). In the 1950s and 1960s, particularly in UK, the aerospace industry has gone through severe trauma such as increases in project cost and a declining reputation from being the major supplier in the world (Nobbs 2008). Considerable time is invested to realise the potential of collaboration as one of the effective solutions to maintain the growth. The aerospace industry is undergoing major changes and the last few decades have seen extensive mergers and acquisitions. Furthermore, AeIGT's 20-year vision for the UK aerospace industry states the need of competition at value chain level comprising a network of inter-connected firms, rather than firm level.

Supplier functional capabilities such as Research and Development (R&D), production and support services are important in deciding the particular form of governance structure to guide the transaction process in BSC. The core functional capabilities are central to resource-based theories of firm-specific advantage (Kogut and Zander, 1992; Mahoney and Pandian, 1992; Martin and Salomon, 2003) and in context of the aerospace industry it is particularly important (Mayer, 2006; Mayer & Argyres, 2004; Martin & Salomon, 2003). Despite a growing interest in collaborative activities, the nature of the relationship required between capabilities and governance are not adequately discussed. Spekman et al. (2002) argue that companies, who value a culture of collaboration and learning across the supply chain, need to be more responsive, adaptive and flexible. The process to identify and develop the capabilities or skills required for better performance in buyer-supplier collaboration is complex and therefore a great deal of attention is indispensable to address it. Research at dyadic level of SC is essential in order to understand the challenges and risks of the mutual commitment and cooperation. Empirical studies examining the linkage between focal firm's capability and SC collaboration performance are rare in the literature (Oh and Rhee 2008). Furthermore, the literature also acknowledges the importance of firm capabilities in governance decisions (Leiblein and Miller 2003). By studying the effect of

governance mechanisms on the relationship between supplier capability and buyer supplier collaboration, this investigation seeks to explain the synergy between supplier capability, governance and collaboration.

### **1.3 Research significance**

This research is significant in light of the limited understanding of the linkage between capability, governance structure and type of buyer supplier collaboration to achieve greater performance. The potential contribution of this research is twofold: *first*, in terms of academic contribution, this study: (a) combines the argument of the RBV (Penrose 1959, Barney 2001b, Prahalad and Hamel 1990, Grant 1991) and TCE (Williamson 1979) to explain the role of governance in the relation between capability and collaboration, and (b) supports the recent ongoing argument of extended RBV (Mathews 2003a, b; Lavie 2006) which includes the incorporation of the capability related to inter-organisation exchange as the sources of competitive advantage. *Second*, in terms of practical contribution, this study: (a) assists managers in understanding the synergy between supplier capability, governance mechanism and buyer-supplier collaboration, (b) helps the supplying firm in taking decisions related to adopting a particular form of governance mechanism according to the capabilities it possesses, and (c) will also be beneficial for the buying firm in understanding the supplier's willingness to prefer the contractual agreement or building the relationship in collaborative engagement. As a result, the buying firm will be more open to either of the inter-firm governance structures while engaging in collaborative arrangements with the supplier.

Buyer supplier collaboration has been established as an active area of management research for several decades or more. Most of the research (Inkpen 2000, Luo 2002, Zhang et al. 2003) discusses different aspects of collaboration focussing on inter-firm information sharing, inter-firm power balance, inter-firm relations, governance mechanisms and related issues in the literature. Some research (Bennett 1997, Cousins 2002, Pender 2008) identifies several forms/types/levels of collaboration and discusses that a focussed approach is vital for their successful implementation. While several research themes have examined the importance of collaboration in the supply chain, there is a gap in the literature regarding the interaction between supplier capability and collaboration performance (Oh and Rhee 2008). Most

research has ignored the interaction among supplier capabilities, governance mechanism and buyer supplier collaboration types. This research investigates the role of contractual and relational governance on the relationship between supplier capabilities and collaboration. The influence of technological uncertainty and competitive business environment on the relation between capability and governance type is also explored. Governance mechanisms based on contracts or inter-firm relations are important guiding forces for collaborative activities and its performance. This study develops the understanding of the capability dynamics, the complementarity of the contractual and relational governance and performance in buyer-supplier cooperation.

Global competitive business environment have seen an increasing trend of collaboration in order to create sources for sustainable competitive advantage (SBAC 2008, WEAFF 2008). Moreover, the SC21 initiative highlights the importance of SC collaboration and suggests that increased competition can be effectively tackled by firms working together at all levels of the SC. Consequently, firms are involved in expanding their boundaries to share and acquire resources to create value for customers. Macpherson and Wilson (2003) argue that organisations need to consider the advantages of collaboration as a route to disseminating learning throughout their supply chains. From an SME perspective, they further argue that the move towards more collaborative arrangements will cause difficulty unless the appropriate capabilities already exist or are developed in-house by the organisation.

Although collaboration is widely discussed in management literature, its real-life implementation still poses a great challenge for managers. In spite of government initiatives and the research conducted, the lack of synergy among organisations is still being highlighted as one of the contributory factors for less growth. There is a lack of understanding in SMEs on the part of understanding the skills and competence level required to respond in the changing business context (Lange et al. 2000). While past studies have showed the long-term benefits of inter-organizational cooperation, there is a lack of clarity in current business practice over the relationship between supplier capability and performance in the supply chain. Although the partner selection process is an important step in collaboration,

one also needs to understand the capability required to further strengthen the collaborative relationship. Combining the capability-based perspective with transaction cost economics will be helpful in developing the understanding for aligning the governance structure with the skills and expertise of the supplier. Major aerospace companies in UK agree that the SC21 initiative is making progress towards developing a competitive supply chain, but also stresses that more supplier contribution is required at each level of the supply chain (SBAC 2008).

#### **1.4 Research aims and objectives**

While previous literature (Blomqvist and Levy 2006, Hardy et al. 2003) has discussed the impact of collaboration on firm performance, literature in management research have neglected the importance of firm-specific factors, which influence collaborative performance. Moreover, buyer supplier collaboration from the buyer perspective is discussed in literature, whereas studies reflecting supplier perspective are rare (Oh and Rhee 2008). This research seeks to explore the relationship between supplier capability and the type of buyer-supplier collaboration. Based on past literature such as Chen and Chen (2003), Jacobides and Winter (2005) and Oh and Rhee (2008), three types of the most prominent functional capabilities are identified as R&D, production and support capability. Two types of the most common governance mechanisms discussed in this research are contractual and relational governance (Poppo and Zenger 2002, Lee and Cavusgil 2006). Contractual governance relies on contracts and legal stipulations to govern buyer-supplier collaboration. On the other hand, relational governance emphasises on building the trust and relationship to control the buyer-supplier exchange process. Three types of BSC are considered in this study: information sharing, collaborative product development, and collaborative problem solving.

Literatures (Barclays and Brock 1997, Poppo and Zenger 2002, Wuyts and Geyskens 2005) have discussed that contractual and relational both forms of governance mechanisms are important in mitigating opportunism and improving collaboration. However, the relationship of supplier capability with BSC in the context of governance mechanism still needs to be addressed. Moreover, the relative effectiveness of contractual and relational governance in supplier capability

and buyer-supplier collaboration relationship also needs attention. Literature has opposing views on whether contractual and relational governance act as complementary or substitutive mechanism. The theoretical underpinning of this research is influenced by the arguments proposed by RBV of the firm and TCE approach to governance. The key objects of this research are: *first*, to understand the effect of contractual and relational governance on the relation between supplier capability (R&D, production and support) and type of buyer supplier collaboration (information sharing, collaborative product development and collaborative problem solving); *second*, to examine and gain insight in the relative influence of contractual and relational governance on the supplier capability and collaboration relationship. This study, therefore, seeks to address the following research questions:

- 1. What is the role of contractual and relational governance in linking supplier capability with buyer-supplier collaboration?*
- 2. How does the contractual and relational governance individually affect the relationship between supplier capability and collaboration type?*

These research questions are investigated in the context of buyer - supplier dyad. More specifically, the research aims to understand the nature of governance mechanisms and its relative importance in supplier capability and buyer supplier collaboration relation. The choice of governance mechanism is influenced by the degree of asset specificity (Williamson 1985), appropriability (Oxley 1997, Pisano 1990) and observability (Holmstrom, 1979) in an exchange. Asset specificity refers to the transferability of assets to alternative uses (Williamson 1985). Appropriability refers to contracting hazards that expose valuable intellectual property to expropriation (Gulati and Singh, 1998; Oxley, 1997; Pisano, 1990). The observability refers to exchange hazard when the quality of collaborative output is difficult to observe and measure ex post (Holmstrom, 1979).

In summary, this study asks, how the governance mechanism supports supplier capability to gain the benefits of collaboration in buyer-supplier dyad and why the synergy between capability and governance mechanism is important in order to



maximise the benefits of collaboration. The following section presents the structure of the thesis.

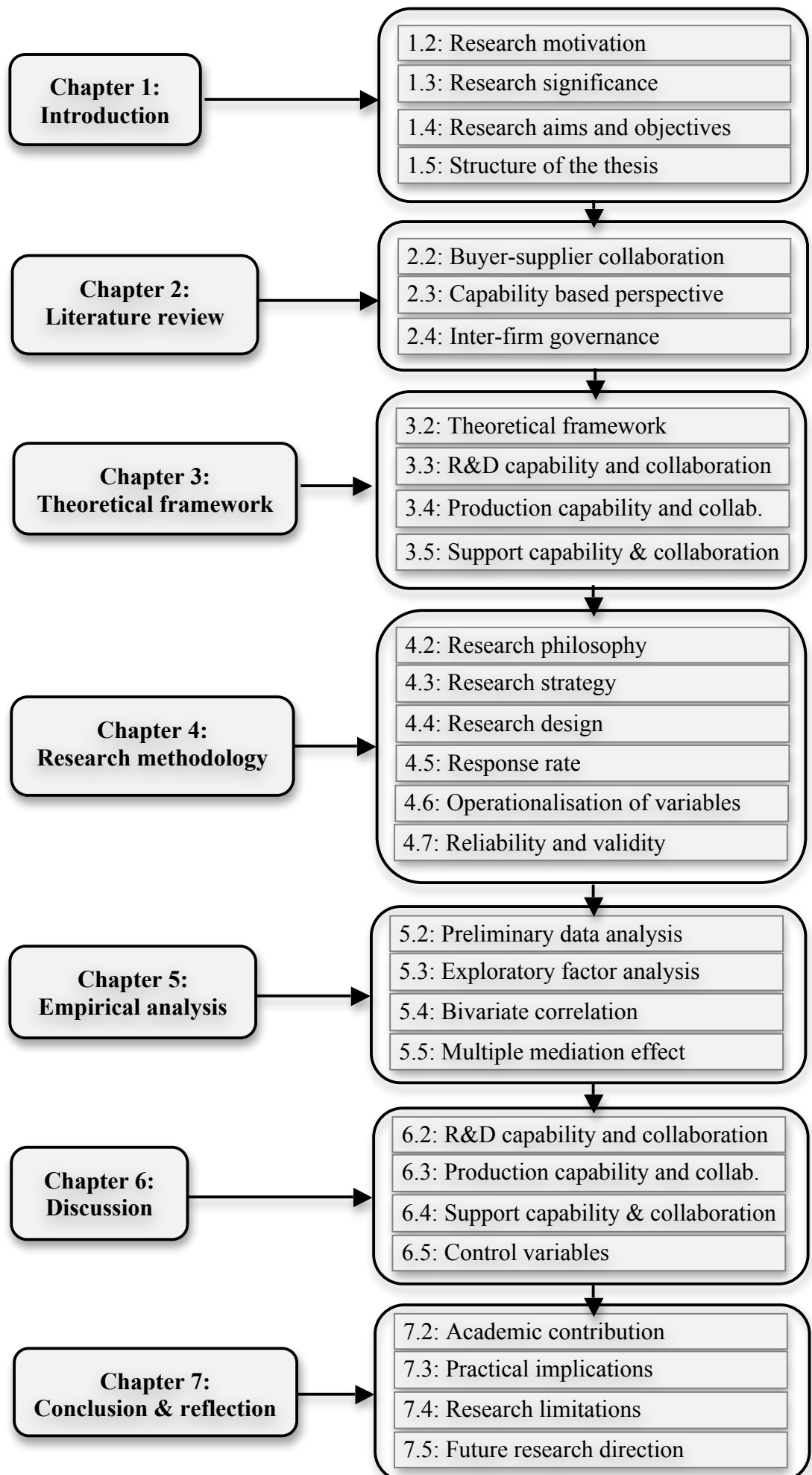
### **1.5 Structure of the thesis**

This section provides a brief description of the subsequent chapters of this thesis. The structure of the thesis is presented in Figure 1.1. Brief information about all the chapters is presented as follows:

**Chapter 1: Introduction** - outlines the research idea and motivation in aerospace industry. It presents the academic and practical contribution of the research. Research aims and objectives are also presented in this chapter. The chapter ends with providing a structure of the thesis.

**Chapter 2: Literature Review** – reviews the literature under three categories: Buyer-supplier collaboration, capability based perspective and inter-firm governance. Extensive literature in buyer-supplier collaboration, buyer-supplier relationship, capability based view, and contractual and relational governance are discussed in this chapter. The chapter ends with summarising the key themes and issues.

**Chapter 3: Theoretical Framework** – presents the theoretical framework of this research. A number of hypotheses are proposed based on the interaction among internal capability, governance mechanism and buyer-supplier collaboration. The chapter discusses the effect of governance mechanism on the relationship between supplier capability and buyer-supplier collaboration types.



**Figure 1.1:** Structure of the thesis

**Chapter 4: Research Methodology** – discusses the research philosophy and methods used to address the research questions and objectives. The chapter provides information regarding the selection of the research strategy and design. Furthermore, data collection techniques are investigated in association with the research problem. At the end, the operational measures of dependent, independent and control variables are presented.

**Chapter 5: Empirical Analysis** – presents the statistical analysis of the data collected during the research process. The chapter discusses the techniques used for preliminary data preparation. Exploratory factor analysis and bivariate correlation are also presented. Finally, the findings of the multiple mediation analysis are discussed.

**Chapter 6: Discussion** – presents the arguments behind the results obtained during the data analysis phase. Multiple mediation effect of contractual and relational governance is supported with the previous literatures. The relative importance of contractual and relational governance in context of capability – collaboration relationship is also discussed in this chapter. The effect of control variables on the results obtained is also presented at the end.

**Chapter 7: Conclusion and reflection** – presents the theoretical and practical contribution of this research. The research limitations and future research direction are also discussed.

## **1.6 Summary**

This chapter introduces the research problem and defines the boundary of the research. The research gap is identified, and discussed in terms of the supplier perspective of buyer-supplier collaboration. It has been argued that accelerating technological change and uncertainty in the aerospace industry identify the opportunity to engage in collaborative activities along the supply chain. The need to understand the interaction among suppliers' capability and collaboration performance is recognised in management literature. Current research focuses in the aerospace industry to explore the relationship between supplier capability,

governance mechanism and collaboration type. The academic and practical significance of the research is discussed in this chapter. Proposed research is significant in terms of providing an understanding of synergy between capability, governance and collaboration. This research can provide guidance for the selection of appropriate blend of contractual and relational governance in collaboration based on the expertise of the firm in production, research and development, and support services.

## **CHAPTER 2**

### **LITERATURE REVIEW**

#### **2.1 Introduction**

This research explores the relationship between supplier capability and buyer supplier collaboration (BSC). This chapter reviews literatures in three broad areas of BSC, capability based perspective and governance mechanism of inter-firm exchanges. This chapter is organised as follows: *Section 2.2* discusses the BSC and its characteristics; *Section 2.3* discusses the firm specific capabilities and presents the capability-based perspective of collaboration. *Section 2.4* describes the inter-firm governance based on contractual and relational mechanism to administer the inter-firm exchange process. Finally, *section 2.5* summarises the key topics discussed in this chapter.

#### **2.2 Collaboration**

In this global business environment, as the competition among firms becomes fiercer, it is not possible to do everything inside the firm for better performance (Limerick et al. 2002). Firms need to adapt an inter-organisational perspective to look into collaborative resources and capabilities to search for sources of competitive advantage. Giunipero et al. (2008) present a review of the literatures in supply chain management (SCM) and placed the collaboration/alliance as one of the top 3 key areas of research in past decade. They argue that the concept of SCM was first mentioned in the study of Forrester (1961) who talks about the importance of interactions between flows of information, materials, manpower and capital equipment for successful business. However, the term SCM didn't come in picture till early 1980s and most of the theoretical and empirical investigation started in 1997 (Giunipero et al. 2008).

Powell et al. (1996) describe collaboration as the medium that provides entry to a field where relevant knowledge is widely distributed which can't be easily produced inside the boundaries of the firm, but can be easily obtained through market transactions. Moreover, Collaboration occurs when a group of autonomous stakeholders of a problem domain engage in an interactive process, using shared

rules, norms, and structures to act or decide on issues related to that domain (Gray 1989, Wood and Gray 1991). The research publication in the area of buyer-supplier collaboration has been increasing since last decade (Giunipero et al. 2008). Tanner (1999) shows that the development of long-term strategic collaboration between buyers and sellers within the SC offers opportunities to create considerable competitive advantage. Giunipero et al. (2008) further identify the lack of research in SCM literature in systematic and empirical examination of the collaboration between SC partners. After reviewing 405 articles in this area, they find out that the empirical analysis at dyadic level is more prominent in SCM literatures. Johnston et al. (2004) also argue that building and managing buyer-supplier collaborative arrangement is one of the most important aspects of the SCM.

### **2.2.1 Characteristics of collaboration**

Collaboration plays an important role in the process of sharing and acquiring complementary resources to create value for customers. It is studied at dyadic, supply chain and supply network levels. In current competitive business scenario, companies want to concentrate more on their core area of expertise and thereby increasing the need of collaborating with other organisations to gain access to complimentary capabilities (Nesheim 2001, Crute et al. 2008). SC collaboration is treated as cooperative activity beyond the simple transaction, undertaken by two or more parties with planned positive outcomes for the participants (Pender 2008). Kanter (1994) identifies collaboration as a living and evolving system, not just a deal or transaction. She also points out that a good partner can become a key corporate asset, which can become a “*Collaborative advantage*”. In this research, collaboration, alliance, and joint ventures are treated as a part of the common theme of co-operation among two or more firms.

Child and Faulkner (1998) argue that collaboration is essentially about learning where two organisations learn from each other’s experience and creativity. Sharing of information and knowledge exchange among partners are the key activities in SC collaboration. Learning is easier when the level of transparency and openness is high. Moreover, Dyer and Noboeka (2000) talk about learning through collaboration and discuss the example of Toyota production network, where regular patterns of interactions among individuals facilitate the transfer, recombination and

creation of specialised knowledge. In addition, some research argues that collaboration is the mechanism to create and share knowledge among partners. Nonaka and Nishiguchi (2001) argue that knowledge is intangible, boundary less and dynamic and it should be exploited where and when it is needed to create value. Hardy et al. (2003) state that while collaboration can facilitate the sharing of extant knowledge from one organisation to another, it can also create new knowledge that neither of the collaborative partners previously possessed. A firm's ability to access external knowledge has the potential to affect its long-term competitive position in the market. In case of rapid product development, external suppliers have to give greater importance to share knowledge with the prime manufacturer (Kogut 2000). Powell et al. (1996) argue that collaboration becomes more reputable and successful where firms are sustaining the ability to learn via interdependent relationships through vertical integration. In an attempt to provide a comprehensive theory of collaboration, Wood and Gray (1991) discuss six theoretical perspectives that may be used to examine and explain collaborative behaviour as; resource dependence, corporate social performance/institutional economics, strategic management/social ecology, microeconomics, institutional / negotiated order, and political.

On the basis of the collaboration objective, firms shape its strategy to involve in collaborative activities with particular partners. For instance, firms collaborate with customers to accurately define their needs and with suppliers to fulfil customers' needs accurately. Collaboration provides a unique opportunity to leverage firms' strength with the help of partners and spread the risks of capital investment, innovation and shrinking product life cycles due to the inability to predict an uncertain future (Mowery et al. 1996, Inkpen 2000). Moreover, collaboration results in providing both tangible and intangible benefits (Simonin 1997). Tangible benefits include financial advancement, improved market share and sustained competitive advantage. On the other hand, intangible benefits include learning and knowledge-based advantages like learning specific skills and competencies from partners. In addition, Kale et al. (2000) argue that intangible benefits for the collaborative partners can be categorised into three types of learning: (i) partners can access and internalise some of the specialised knowledge of their collaborative partners, (ii) collaborative partners can learn about managing the collaboration

process and (iii) collaborative partners can learn how to better manage the inter-firm relationship.

Coughlin et al. (2003) argue that despite having many benefits of collaboration, it is a complex form of inter-organisational relationship. It should only be adopted after a careful consideration of the pre-collaboration activities. Some of the important pre-collaboration activities are summarised as follows (Inkpen 1998, Inkpen and Li 1999):

- Assess the value of the partner's knowledge, its accessibility and ease of transfer
- Understand the potential inter-firm activities to share knowledge and innovation
- Assess the feasibility of alignment of resources with the collaborative partners
- Clearly understand the partner's capabilities and whether the initial relationship is adversely affected by past events
- Understand the issues that are negotiable and then negotiate for mutual value creation
- Understand the possible risks involved and place safeguards to minimise it
- Establish a mechanism to review the collaboration outcomes

Inkpen (2005) discusses some of the key problems in collaboration, which need to be understood properly. Firms often fail to understand the capabilities of partners and alignment of resources with the collaborative firm. Firms with greater power are often obsessed with collaboration ownership and discount the learning opportunity (Hamel et al. 1989). Often firms are unwilling to incur the cost of collaboration set-up and learning-oriented systems and treat these issues as costs rather than investments. Learning and knowledge often dissipate through individuals involved in the collaborative activities, which often seems hard to get across to the top level of management. Intellectual property right is one of the key barriers to SC collaboration. Dyer and Noboeka (2000) argue that intellectual property rights may well reside within the collaboration level (either dyadic or network) rather than at the firm level. Toyota provides an interesting example of



collaboration in the supply network. Toyota assists members along the supply chain to develop rules for knowledge protection and value appropriation. Individual members of the network share a collective sense of purpose, goals and values for the collaboration. Firms collaborate with each other to acquire or share a range of complementary tangible or intangible resources to create value for customers. Recent literature on collaboration (Inkpen and Crossan 1995, Gerwin 2004, Crute et al. 2008, Gutierrez and Serrano 2008, Pender 2008) argues that nature and specific objectives of collaboration need to be properly addressed to have better performance in collaborative arrangements.

Studies conducted by Sagawa and Segal (2000), Iyer (2003), and Wymer and Samu (2003) argue that motivations for entering into collaboration might be linked with the strategic or tactical outcomes. Some of the researchers such as, Polonsky and Speed (2001) and Polonsky et al. (2008) describe two forms of collaboration based on the nature of its objectives as, tactical and strategic collaboration. Literatures such as, Bucklin and Sengupta (1993), Huxham and Vangen (1996), Milne et al. (1996), Sengupta and Perry (1997) and Rondinelli and London (2003) have discussed a range of collaborative arrangements between organisations. Bennett (1997) describes the collaboration in airline industry as two types of partnership, which can be categorised as informal and formal. According to him, informal partnerships are loose forms of collaboration, which do not usually involve major resource commitments, and as a result, they are not high risk in nature, whereas formal collaboration is a particular mode of inter-organisational relationship in which partners commit to make substantial investments in developing a long-term collaborative effort and common orientation. Collaboration is also classified in tactical and strategic terms in uncertain business environment (Cousins 2002). Menon and Menon (1997) discuss that strategic collaboration involves sharing of extensive resources and skills that may have the capability to decide the focus of the organisation; whereas tactical collaboration focuses mostly on functional activities and requires less substantial change in the organisation. Moreover, strategic collaboration includes complex sets of activities and in contrast, tactical collaboration involves minimal information sharing where organisations operate at arms length with focused programmes (Rondinelli and London 2003).

Crute et al. (2008) discuss the industry-wide vision for SC collaboration and identify different forms of collaboration in aerospace sector. They develop a collaboration model to describe the purpose, nature and likely participants in a variety of collaborative arrangements across the industry. At the supply chain level, Barratt (2004) also identifies three levels of inter-organisation integration as operational, tactical and strategic. Despite a growing awareness of tactical and strategic collaboration, this research tends to emphasize on strategic aspect more than its tactical importance. Discussion in this section has highlighted the characteristics of collaboration. A better understanding of the relational between capability and governance is needed to explain the performance in collaboration.

### **2.2.2 Buyer-supplier collaboration**

The intention behind Buyer-supplier collaboration is argued as the focus on the core area of expertise and gain access of complementary resources/capabilities from potential collaborative partner to maintain sustainable competitive advantage (Nesheim 2001, Crute et al. 2008). Buyer-supplier Collaboration (BSC) provides a unique opportunity to leverage each other's strength and spread the risks of capital investment, innovation and shrinking product life cycles due to uncertain future (Mowery et al. 1996, Inkpen 2000).

The supplier's perspective of collaboration is discussed in this research, which is comparatively less discussed in previous literature on collaboration (Oh and Rhee 2008). Previous literatures have highlighted the importance of BSC in context of growing competition (Gray 1989, Wood and Gray 1991), but the holistic view of collaboration including the firm capability and governance mechanism has received limited attention in literature. This study argues that, although supplier capability is influential in deciding the level of BSC, the exchange process is also critical in efficient sharing of resources between buyer and supplier. Similar arguments have also been proposed in the studies of Hoetker and Mellewigt (2009) and Li et al. (2010). Successful collaboration is based on the optimal combination of productive resources across partners and the mitigation of risk due to opportunistic behaviour (Mitchell et al. 2002, Nickerson and Zenger 2004, Hoetker and Mellewigt 2009).

Literatures investigating buyer-supplier collaboration has grown consistently over past few decades (Terpend et al. 2008). This increased interest has expanded towards studying various aspects of BSC in response to the perceived need for a careful consideration of the changes that have been taking place across the business world. Kanter (1989, 1994) argues that buyer-supplier relations must give the utmost importance to the formation of collaboration. Close and intense interactions between individual members act as an effective tool to transfer tacit knowledge across the firm boundary. Moreover, Bensaou and Anderson (1999) discuss that firms find difficulty in doing everything alone in the era of increased uncertainties, rapid technological progress and growing global competition. As a result, BSC may represent an important source of competitive advantage. For instance, guest engineer programmes initiated by some of the companies are based on the interdependence to create value for customers. This provides an opportunity for suppliers to work closely with the manufacturers to understand and learn product development processes (Liker and Choi 2004).

A few studies (Gouldner 1960, Macneil 1978, Axelrod 1984, Zaheer et al. 1998) discuss BSC as characterised by information sharing, frequent interactions, mutual trust and cooperation for mutual gain. In contrast, arms-length behaviour is described in terms of minimal interaction, multiple suppliers, spot contracts and opportunism (Williamson 1985, Sako 1992). Although these are two extremes of buyer supplier collaboration, normally it widely varies from partnership approaches to vertical integration (Williamson 1985). Allocation of resources and strength of the relationships could be important measures for the successful collaboration and it needs to be focussed at product, service or commodity level (Olsen and Ellram 1997). The type of collaboration depends on the level of output desired, that is based on the amount of resources needed and level of return anticipated (Lamming 1993, Cousins 2000). BSC collaboration is a very broad and encompassing term (Barratt 2004). In order to maximise the performance of such collaboration, there is a need for deeper understanding of different aspects of it.

Based on the prior studies of Chen and Paulraj (2004), Das *et al.* (2006), Kaufman et al. (2000), Narasimhan and Kim (2002), Oh and Rhee (2008) and Cai et al. (2009), three categories of BSC are identified for the purpose of this research as,

Information Sharing (IS), Collaborative Product/service Development (CPD) and Collaborative Problem Solving (CPS). These three categories of BSC are based on the purpose, nature, time scale and the type of resources involved in the exchange process. IS is important in the entire life cycle of the product, CPD is particularly important during the new product development stage and CPS is important during the production stage when there is a need to solve routine problems with regard to cost, quality and delivery. The nature of resource exchange in all of these BSC types varies from physical to knowledge resources. The purpose of the collaboration types are mutual understanding of each other due to effective information sharing, ensuring the quality of the product at the early stage and providing immediate solutions to problem occur during the production process. The collaboration types selected in this research are comprehensive to cover the most critical activities in BSC and provide a snapshot of the variety of activities involved in BSC.

Activities in IS include the timely, efficient and regular exchange of information related to products and services, price and market conditions, production process and delivery schedule for mutual benefits. CPD includes activities related to active involvement of supplier in new product development from the early stage with the aim to improve the product quality, development time and, share the cost and risks associated with the product development. The objective of CPS activities is to look for possible ways to solve routine problems related to product cost, quality, delivery schedule and uncertain demand pattern without having any ill impact on both buyer and supplier. These problems can include frequent change in the cost of the components, low quality products, and delivery failure in mass production stage.

### **2.3 Capability based perspective**

As BSC gain more importance, the capability of the partner firms exerts crucial influence in determining the success of that collaboration. Although a number of studies can be found in the area of buyer-supplier collaboration (Wood and Gray 1991, Olsen and Ellram 1997), there are limited studies focusing on the relationship between supplier's capability and BSC types (Oh and Rhee 2008). While boundaries of the firm are unquestionably influenced by inter-firm collaborative

activities, the capability-based perspective facilitates the understanding of why organisations differ in their performance in the collaboration (Kogut and Zander 1992, Flowers 2007). The capability-based approach has received increased attention in recent times, which focuses on the firm's tangible and intangible resources as the basis for sustainable competitive advantage (Hamel and Prahalad 1994). According to Penrose (1959), only possessing resources may not be sufficient and firms also need to develop the capabilities to make valuable use of their resources.

While firm's expertise in functional process like production, marketing, services and R&D are discussed as the internal capability of the firm, there is limited discussion over capabilities related to the efficient management of inter-firm transactions. In this research, the internal functional capabilities and the impact of the type of the resources on inter-firm exchange process are explored. It is evident in the practice that firms having better inter-firm exchange management skills have shown better performance in collaboration (Bidwell 2010). Gulati (1999) also argues that firm's capability can influence the process of alliance formation. The decision to maintain and develop specific capabilities is influenced by the firm's intent to involve in collaborative arrangements and expectation of economic gain from it. In this section the distinctive capability and capability-based view of collaboration is discussed.

### **2.3.1 Distinctive capability**

Distinctive capability describes the activities, resources or skills of an organisation that refers towards its special strengths and expertise (Selznick 1957, Penrose 1959). Management literatures (Andrews 1971, Hofer and Schendel 1977) often relate distinct capability with the competitive advantage of the firm. Andrews (1971) argues that distinct capability captures the ability of the organisation to do well relative to competitors. Hart (1995) explains that firm's capability results from bundle of resources brought together to create value in the business processes such as designing, production etc. Teece et al. (1997) define resources as the firm specific assets that are difficult (if not impossible) to imitate such as trade secrets and engineering experiences and argue that such assets are difficult to transfer as they may contain tacit knowledge. Similarly, Wernerfelt (1984) defines resources

as the tangible and intangible assets which are tied semi-permanently to the firm. A resource can belong to a firm or be accessed by it. Mills et al. (2003) classify resources in six different categories as (i) tangible resources, (ii) knowledge, skills and experience, (iii) system and procedural, (iv) cultural resources and values, (v) network resources, and (vi) resources with potential dynamic capabilities. Furthermore, Loasby (1998) defines capability as a particular kind of knowledge and skills, which generates sources of competitive advantage. It describes the firm's ability to integrate, build, and reconfigure internal and external competences (Teece et al. 1997). Moreover, Leonard-Barton (1992) defines dynamic capability as an organisation's ability to achieve new and innovative forms of competitive advantage according to market position. Taking a comprehensive view, capability is defined here as the ability of the firm to manage the resources to create sources of competitive advantage. It can be physical, human or organisational capability (Becker 1964, Williamson 1975, Hofer and Schendel 1977, Tomer, 1987).

Literatures in operations strategy identify a wide range of capabilities, which can provide sources of competitive advantage (Asanuma 1985, Kogut and Zander 1992, Neely et al. 1995, Stalk et al. 1996, Noble 1997, Boyer 1998, Liker et al. 1998, Hoetker 2005, Goffin et al. 2006, Jacobides 2006). Oh and Rhee (2008) provide a long list of different types of supplier's capabilities, such as; process capability, dependability improvement capability, cost reduction capability, quality improvement capability, flexibility capability, technology capability, design capability, engineering capability, supplier evaluation capability, module capability, coordination capability, supplier development capability, customer proliferation capability, responsive capability and combinative capability. Subsequently, Chen and Chen (2003) and Jacobides and Winter (2005) subdivide resources/capabilities into four categories: production, R&D, marketing, and purchasing capabilities. Goffin et al. (2006) argue that buyers select suppliers who have greater R&D capabilities. It is found in the automobile industry that the greater the R&D capability of the supplier the more active their collaboration in new car development (LaBahn and Krapfel 1999, Liker et al. 1998) and information sharing with the car maker (Hsuan 1999, 2003). Further, Mayer and Salomon (2006) argue that capabilities come in many forms and variations based on technological, managerial, operational, marketing etc. In summary, it can be

argued that capabilities of the firm can be categorised based on the physical and knowledge resources/assets (Hoetker and Mellewigt 2009).

George (1994) argues that every business develops its own configuration of capabilities on the basis of its competitive market, past commitments and anticipated requirements; therefore it is not possible to identify all possible capabilities. However he further points out that certain type of capabilities related to core processes of the firm such as production, services, R&D can be recognised in all businesses. If a firm lacks the capability required to build sources of competitive advantage, it will promote collaboration to secure those capabilities from other firms (Erramilli and Rao 1990, Ingham and Thompson 1994). There are ample reasons available in the literature to assume that the strategic core of the firm is not exclusively governed internally. Dyer and Singh (1998) argue that firms who combine resources in a unique way may be able to outperform firms that are unable to do so. Collaborative capability is considered as the prerequisite for partners if they wish to leverage complementary knowledge and innovation in collaboration (Blomqvist and Levy 2006). It can be considered as a subset of dynamic (Teece et al. 1997) and combinative capability (Kogut and Zander 1993). Moreover, collaborative capability is useful in understanding and analysing the relational interaction on multiple levels of organisation-wide collaboration (Blomqvist and Levy 2006). In addition, Helfat and Peteraf (2003) introduce the concept of capability lifecycle, which articulates general patterns and paths in the evolution of organisational capabilities over time. Their analysis incorporates the founding, development and maturity of capabilities in a manner that helps to explain the sources of heterogeneity in organisational capabilities. Based on the orientation and focus of the defining processes, George (1994) classifies capabilities in three categories as inside-out capability, outside-in capability and spanning capability. Inside-out capability is activated by market requirements, competitive challenges and external opportunities and some of the examples of this category are manufacturing, logistics etc. Outside-in capability enables the business to compete by anticipating market requirements ahead of competitors and create durable relationships with customers and suppliers. Spanning capability is required to integrate the inside-out and outside-in capabilities.

Although, BSC involves development, communication and reinforcement of shared goals and objectives, it also involves emphasising capability development to facilitate rather than hinder knowledge exchange and information sharing. Development of firm-based capabilities must occur before learning outcome can be identified through collaboration and it can not be ignored by having a sole focus on the content of the collaboration (Pender 2008). Although, experience may be thought as a predictor of future success in collaboration, there is no direct link between collaboration experience and collaboration outcomes (Simonin 1997). Simonin finds that experience alone is insufficient for greater benefits in collaboration. Firms that align the capability with the type of collaboration activities effectively outperform others, but a rigid set of managerial beliefs associated with unwillingness to align the capabilities can severely limit the collaboration outcomes. In addition, Szulanski (1996) also argues that development of absorptive capacity through a shared mindset of '*enquiring minds*' provides conducive environment for knowledge transfer and shared creativity. The innovative nature of suppliers may provide fertile ground for creating value from the collaboration.

In this study, three key functional capabilities of the supplier are identified based on the most widely discussed capabilities in previous literatures. These are Research and Development (R&D), production and, support services capability. Supplier's *R&D capability* refers to proven ability to involve in research and development (R&D) activities and consistently applying this to enhance the performance of product and services. *Production capability* corresponds to the proven ability of the firm, to consistently provide components or finished products to the buying firm according to buyer specifications; to reduce production cycle time; to deliver products on time; to cope with uncertain demand; to provide low rate of product failure due to quality problems; and to reduce production cost. The supplier ability to be flexible and dependable to provide the quality product to the buyer at low cost is also included in the production capability. *Support services capability* refers to the proven ability of the firm to provide effective support services related to the product according to buyer's requirements such as maintenance services, technical support services etc. Reducing the waiting time for support services, consistently provide quality support services at promised time and



dealing with the urgent support requests are some of the important parameters of the support services capability (Lai 2004, Parasuraman et al. 1994).

R&D, production and support capabilities in this study are selected based on the nature of resources (Physical and Knowledge) involved in developing these capabilities and its wider presence in SMEs. These three capabilities also represent the continuum of the product life cycle (Chen and Chen 2003). R&D capability can be most useful during the product development stage, production capability can be more effective during the production process, and the support services capabilities can be desired after the sale of the product, during the maintenance and after-sales support. The choice of R&D, production and support capabilities in this study is also supported by previous literatures in operations strategy, which have formulated the capability around the common theme of R&D, production and support activities (Boyer 1998, Neely et al. 1995, Noble 1997).

In summary, this section has highlighted the different classification of capabilities in literatures and justified the selection of functional capabilities (R&D, production and support capabilities) for the purpose of this study.

### **2.3.2 Capability based view**

The capability-based view of the firm is widely discussed in operations strategy literatures. It focuses on the role of strategic resources and capabilities as sources of economic rents and sustainable competitive advantage (Barney 1991, Grant 1991).

The argument of the Resource-Based View (RBV) of the firm can be traced back to the primary idea of Penrose (1959). Penrose argues that the unique character of each firm depends on the productive services available or potentially available from its resources. Penrose (1959) further discusses that only possessing resources may not be sufficient and firms also need to develop the capabilities to make valuable use of their resources. A number of scholars in the 1980s (such as Wernerfelt 1984, Barney 1986, Dierickx and Cool 1989) argue that past literature in strategic management focuses too narrowly on the product-based view of the firm, which relies on privileged product market positions as the basis for competitive advantage of the firm. They argue that most of the literature overlooks the importance of resources which are required to produce the privileged products.

Based on the argument that products are transformed forms of the bundle of resources, RBV later emerged as one of the most prominent theories in strategy management literature.

Similarly, Barney (1991) provides a detailed and formalised representation of the business level resource-based perspective (Priem and Butler 2001). RBV primarily focuses on possessing valuable and rare resources, which should be hard to imitate and substitute in order to sustain competitive advantage. The traditional idea of owning and creating the resources to develop competitive advantage has now been argued as not very favourable for the global competitive business environment. It has been widely observed that firms do not need to own the resources to assure an efficient flow of goods and services. Merely possessing the valuable and rare resources do not guarantee a firm the creation of value (Barney and Arian 2001). Moreover, Eisenhardt (1989 a) presents an empirical study to illustrate the importance of firms' capabilities. Core-competence (Prahalad and Hamel 1990) and critical capability (Grant 1991) studies also discuss the importance of RBV. Core-competencies are considered as the collective learning in the organisation, especially how to coordinate diverse production skills and integrate multiple streams of technologies. It is also about communication, involvement and a deep commitment to working across many levels of people and functions in the organisation. Competencies can be enhanced as they are applied and shared in the organisation, however sharing of ideas and resources are limited to the organisation only (Prahalad and Hamel 1990).

Although, RBV has often been criticized on two basic points: (a) its inward view and (b) its assumption of firm as an independent entity (Wang and Ahmed 2007), it is still one of the most prominent and established theories for understanding organisations (Barney et al. 2011). Lavie (2006) addresses the limitation of RBV in terms of its incapability to understand the competitive advantage of the inter-connected firms. He argues that the focus on resources that are owned or controlled by the firm undermines the essential contribution of the inter-firm resources. Hunt and Davis (2012) provide a defence for RBV of the firm to understand the issues in supply chain area. A review of the studies on capability-based view of the firm can be found in Wang and Ahmed (2007). They identify that inter-firm resources and

capabilities are one of the important areas to explore. As argued by Barney et al. (2001 a, b), the ability to change quickly in the market is costly for others to copy and thus can be a source of sustained competitive advantage. Leiblein (2011) reviews the basic definitions, assumptions, and propositions offered by the RBV literatures, and provides a comprehensive discussion over the resource-based theories. Lockett et al. (2009) and Kraaijenbrink et al. (2010) also review and assess the principal critiques of RBV evident in the literature, and provide suggestion for combining the RBV theory with other theories like TCE etc. to explain the nature of the functions of firm in current environment. Hunt and Davis (2012)

In last few years, researchers have argued that the capability of the firm need to viewed in the perspective of inter-firm resource exchange and the recent phenomenon of large scale inter-firm collaboration. Gulati (1999) first introduces the notion of networked resources and examines the importance of alliance formation decisions. Recently, literature in operations strategy has initiated a discussion over extending the resource-based view (Mathews 2003a, b; Lavie 2006, Lewis et al. 2010), which includes the issue of sharing the resources to create sources of competitive advantage. Lavie (2006) extends the RBV to explain and understand the strategic behaviour and performance of inter-connected firms. He further identifies the importance of integrated contribution of internal and external sources of competitive advantage towards firm performance. Lavie concludes his discussion of the extended resource-based view with the notion that *'nature of relationships may matter more than the nature of resources in networked environments'*. Squire and Cousins (2006), and Arya and Lin (2007) provide empirical studies supporting the idea of extended resource-based view. However, the idea of extended RBV is still debatable and more research is needed to establish extended RBV as a new theory.

The discussion in this section has highlighted the importance of resource-based view in the perspective of understanding the impact of supplier capability on the buyer-supplier collaboration. Supplier capability is crucial to understand the nature of collaboration and the level of resource commitment required for that collaboration (Asanuman 1985, McMillan 1990 and Goffin et al. 2006). Literature

such as Oh and Rhee (2008) has identified the importance of supplier capability in improving BSC performance.

## **2.4 Inter-firm Governance**

Inter-firm exchange process/governance mechanism is widely discussed in previous literatures (Nooteboom 2004, Mayer and Saloman 2006, Poppo and Zenger 2002, Roath et al. 2002, Ness and Haugland 2005, Lee and Cavusgil 2006, Hoetker and Mellewigt 2009, Li et al. 2010). Williamson (1985, 1991) argues that the transaction cost varies with the type of governance mechanism adapted. Some of the researchers such as Nooteboom (2004) and Mayer and Saloman (2006) put forward the argument of the relationship between capability and governance, and argue that firms also need to adapt a particular governance mechanism for effective inter-firm transaction. Apart from the capabilities related to production, technology, distribution, services, marketing and procurement, firms also need to align these capabilities with governance mechanism to achieve greater collaboration performance. Alignment of resources with the transaction attributes is importance in inter-firm collaboration decisions and studies like Verwaal et al. (2009) argue that combining the concepts of RBV and TCE is effective in explaining the phenomenon.

While prior literatures have focussed more on developing the internal or core capabilities of the firm, there are limited research available in linking the capability with BSC in presence of particular governance mechanism. During our preliminary study, practitioners also seem to agree that there is a relationship between skills required to manage inter-firm collaboration and co-operation performance. George (1994) discusses the process of integrating internal and external capability of the firm to facilitate close interaction between firms. It is argued that collaboration cannot be initiated without the realisation of the firm's own capabilities and the idea of what the firm may need from the collaborative partner. Even after the understanding of capabilities, firms need to adopt an effective governance mechanism to guide and facilitate the process of knowledge exchange and resource sharing. Successful collaboration is based on the optimal combination of productive resources across partners and the mitigation of risk due to opportunistic

behaviour (Mitchell et al. 2002, Nickerson and Zenger 2004, Hoetker and Mellewigt 2009).

In this research the plural form of governance i.e. contractual and relational governance is considered to explain the interaction between capability, governance and collaboration. These governance mechanisms are important to guide the inter-organisational exchange process through formal written agreement or inter-firm relationships. Contractual and relational governance are widely discussed in previous research (Poppo and Zenger 2002). Contractual governance refers to administering the inter-firm exchange process through a formalized, legally binding written agreements/ contracts. It monitors the exchange process and enforces the roles and responsibility of each parties according to the contracts. On the other hand, relational governance refers to administering the inter-firm exchange process through commitment and inter-firm relations. It emphasizes on the role of mutual trust and commitment in the collaborative exchange process. Nooteboom (2004) argues that while capability based view focuses on the boundary of the firm, it cannot ignore the issue of inter-firm governance, especially in case of collaboration. He mentions that there are limited researches that connect capability and governance perspectives and further identifies the need for development of empirical research in this area. Moreover, Pender (2008) summarizes the literature in collaboration and governance structures and some of his key findings are: (i) degree of information sharing and extent of knowledge accessibility increases with the greater trust between collaborative partners, (ii) clarity in collaborative objectives facilitates the initial trust between partners, (iii) if initial trust level is greater, the initial monitoring and control costs due to collaboration decreases and initial reliance on social control increases, (iv) more extensive use of formal contracts diminishes the opportunity for development of inter-firm trust, and (v) repeated successful transactions between partners leads towards an increased level of inter-firm trust. Jiang (2009) reveals that if buyer's governance efforts move away from threat and toward cooperation, supplier's compliance with the contractual terms and conditions could be more sustainable.

Challenges in initiating, maintaining and developing SC collaboration expect managers to articulate the collaborative vision and communicate it strongly inside and outside the firm. Trust and carefully understood relationships can help to overcome these challenges. A collaborative alliance is usually viewed as incomplete contracts with successful outcomes dependent on the ability to anticipate and respond to contingencies that cannot be pre-specified in a formal contract (Anand and Khanna 2000). Governance structure literatures (Zaheer and Venkatraman 1995, Lusch and Brown 1996, Kale et al. 2000, Luo 2002, Lee et al. 2003, Zhang et al. 2003, Delmas and Tokat 2005) describe contractual and relational both governance mechanisms as important factors which affect collaboration performance. Williamson (1985) explains that, in the absence of some forms of governance mechanism, agreements between organisations can suffer from the risks of opportunistic behaviour (Tirole 1993). In retrospect, governance mechanisms tend to be a function of asset specificity, uncertainty, and the willingness of the transaction partners to assume some level of risk (Walker and Poppo 1991, Chiles and McMackin 1996). However, it is still debatable whether a formal contract or mutual trust provides an appropriate environment to facilitate sharing of resources, stabilize the relationships and strengthen the collaborative arrangement.

#### **2.4.1 Contractual governance**

Contracting has been getting more importance in inter-organisational collaborative arrangements through which firms exchange products, services and knowledge (Mowery et al. 1996, Pisano 1989). Transaction Cost Economics (TCE) (Williamson 1979, 1991) is one of the most prominent theories, which explains the governance mechanisms for transaction-based exchanges. TCE argues that the buyer can easily dissolve the relationship in the competitive market with low asset specificity, if the supplier fails to meet the obligations or if the resource is no longer needed (Tirole 1993). These relationships tend to suggest contractual agreement between firms with minimal information exchange and low or no investment in assets. Contractual governance based on contracts emphasizes the formation of written agreements between partners for inter-firm transactions. It reduces the risk of co-operation to facilitate knowledge transfer and as a result, enhances the collaboration performance. Formal contracts represent promises or

obligations to perform particular actions to deal with future contingencies (Macneil 1978). It is seen as a safeguard for opportunistic behaviour and helps to stabilize the relationship (Osborn and Baughn 1990, Kale et al. 2000).

While many researchers like Ghosal and Moran (1996) and Gulati (1995) argue the negative impact of the detailed contract on the co-operative relations, Argyres and Mayer (2007) observe that many firms especially within high-technology industries such as aerospace, computer software & services and biotechnology make efforts to design detailed contracts to manage many kinds of inter-organisational collaborative arrangements (Crocker and Reynolds 1993, Kalnins and Mayer 2004, Lerner and Merges 1998). Lui and Ngo (2004) argue that contracts can reduce transactional ambiguity by listing the issues, which are allowed or not in partnership. Cox (1996) discusses that by emphasizing the importance of transactions as a determining feature of the structure of the firm, Williamson has shifted the focus towards the notion that firms are best viewed as a nexus of contracts (Aoki 1990). Moreover, Ring and Van de Ven (1992) argue that an explicit contract ensures that the terms and conditions of transactions should be followed in the event of any uncertainty. Classical contracts provide an efficient safeguard by which firms protect themselves from partners' opportunism (Macneil 1978, Williamson 1985). As a result, firms may prefer arms-length contractual agreements to control the type and amount of information shared to reduce the risks involved.

Lusch and Brown (1996) further argue that a legal contract may state how various future situations can be handled, thereby decreasing uncertainty about behaviours and outcomes by providing formal rules and procedures to maintain the partnership. The legal and economic consequences of violating a contract make it difficult for partners to take advantage of each other and thereby improve the stability of the collaboration. Parkhe (1993) also discusses that contracts may stipulate penalties that may increase the cost of opportunism. Although partners may not fully follow their contracts word by word, it can still provide a set of normative guidelines if conflict arises. Moreover, Klein-Woolthuis et al. (2002) argue that firms should employ safeguards against the hazards of opportunistic behaviours because one would have never been sure whether and when opportunism will occur. TCE suggests tradeoffs between various tools of formal

control, depending on the degree of asset specificity, uncertainty and transaction frequency (Williamson 1985). Classical contract theory (Lyons and Mehta 1997, Klein-Woolthuis et al. 2002) discusses the guidelines for complete and optimal contracts and assumes that it should be legally binding and should incur lower transaction costs relative to outcome efficiency. Contracts facilitate the exchange process and prevent opportunistic behaviour.

Nevertheless, some of the literatures also argue that contracts act as the foundation for developing inter-firm relationships. It is argued that initially firms design contracts to start the collaborative process, but in the long term, it can be seen as a means of building business relationships and trust between firms (Arrighetti et al. 1997). Deakin et al. (1997) discuss the differences between time-based contracts and argue that long term contracts are more detailed than short term contracts. Some of the firms are obsessed with forming contracts with suppliers, which seems to be not entirely beneficial. For instance, General Motors develops contracts that allow it to shift to a less expensive supplier at a moment's notice, which creates suspicion about its behaviour with suppliers (Liker and Choi 2004). Argyres and Mayer (2007) suggest that contractual governance is more important in safeguarding the assets and knowledge in knowledge intensive industry. However, a better understanding of the roles of trust and commitment is undermining the importance of contractual governance (Hoyt and Huq 2000). Some recent literatures argue that governance mechanism based on inter-firm relations and mutual trust can improve manufacturing firm performance (Handfield and Nichols 1999, Wetherbe 1995, Liedtka 1996, Jones et al. 1997).

In this study, Contractual governance refers to administering the inter-organisational exchange through written formal agreements or contracts. It shows the intent to include the guidelines and possible action plan of the exchange process in the form of the written agreement while working with the buyer. It involves designing of contract, monitoring of contract and handling the unexpected events in future. The contractual governance outlines the roles and responsibilities of each party, expected collaborative outcome, procedures for monitoring the development, procedures for non-compliance and premature termination of the contract.



### **2.4.2 Relational governance**

Relational governance refers to administering the inter-organisational exchange through trust and inter-firm relations. Relational governance emphasizes inter-firm understanding and bonding through socialisation and open communication. Although contractual governance may be effective in collaborations where asset specificity is low, more often it may have the tendency to create conflicts and confusion (Gaski 1984, Hirschman 1984). Several theories like social exchange theories, relational capital theory (Kale et al. 2000) and relational contracting theory argue that mutual trust and commitment are essential coordinating mechanisms to determine the quality of inter-firm collaboration. Some studies (Granovetter 1985, Gulati 1995, Dyer and Singh 1998, Ingham and Mothe 1998) argue that trust between collaborative partners is a partial substitute for contracts. It contributes in lowering the transaction cost and limiting the risks. Mutual trust and commitments are seen as safeguards to avoid opportunistic behaviour in collaboration (Uzzi 1997, Zaheer and Venkataraman 1995, Kale et al. 2000).

Literature in inter-firm relations can be divided into two broad perspectives: the behavioural perspective and the economic perspective (Cousins 2002). The behavioural perspective presents relationships between firms as human-interpersonal relationships, which are based on trust, mutual understanding and co-operation. On the other hand, economic perspective views inter-firm relationships as economic power exchanges between firms within the marketplace. The age of the relationships may impact the effectiveness of the collaboration (Bucklin and Sengupta 1993, Polonsky et al. 2008). The central concept of inter-firm relationships is concerned with the collaboration and sharing of resources, either tangible (such as machinery) or intangible (such as intellectual know-how and technological processes).

Relational governance literatures argue that mutual trust fosters learning and knowledge transfer between firms (Kale et al. 2000). Anderson and Narus (1990) define trust as the belief that the partner performs actions that will result in positive outcomes for the firm and does not take unexpected actions that may result in negative outcomes. Similarly, Ganesan (1994) specifies it as the extent to which the focal firm believes that its partner has intentions and motives beneficial to it. Trust

in the collaborative arrangement is based on the set of understandings between the partners about the expected behaviour in future (Limerick et al. 2002). It is seen as the critical factor for good relations and successful collaboration (Dwyer et al. 1987, Child and Faulkner 1998). In addition, trust facilitates intensive interaction between partners involved, which enables them to transfer and learn complex and tacit knowledge across the firm boundaries. As a result, trust-based relational capital can reduce or eliminate the fear of opportunistic behaviour (Zaheer et al. 1998). Doz and Hamel (1998) argue that ease and smoothness of knowledge exchange depend on the degree of openness and transparency between collaborative partners. Similarly, Dyer and Singh (1998) argue that mutual trust encourages partners to set-up idiosyncratic knowledge sharing routines to facilitate the learning of information and know-how, which can accelerate knowledge transfer. Distrust encourages opportunistic behaviour due to lack of loyalty between partners and deterrence-based trust revolves around the available sanctions for opportunistic behaviours (Macaulay 1963, Gulati 1995, Ghosal and Moran 1996)

Moreover, Morgan and Hunt (1994), and Hewett and Bearden (2001) argue that trust is an important mechanism for persuasion and encouragement of future exchanges and it leads to cooperative behaviour and decreases uncertainty. Sako (1990) categorises trust in three forms: contractual trust, goodwill trust and competence trust. Contractual trust is defined as the trust that partners will adhere to the points of the contract as agreed. Goodwill trust is the trust that the partners will perform tasks in excess of the agreed terms and conditions, if required. Competence trust is the trust that the partner has the ability to produce what the contract requires. Furthermore, Madhok (1995) argues that inter-firm trust has two components: first, the structural component based on the mutual hostage position; and second, the behavioural component based on the degree of confidence partners have in each others' reliability and integrity.

Power is also an essential characteristic of social organisation and an inevitable instrument for inter-organisational coordination (Batt and Purchase 2004). More a single firm seeks to control the collaboration, the less effective and less innovative collaboration becomes (Hakanson and Ford 2002). Greater inter-firm relations may

discourage firms to exercise and impose legitimate power on collaborative partners (Macneil 1981). Charan (1991) argues that interaction between firms should be open and visible that builds trust, empathy and secures relationship. Kale et al. (2000) discuss that inter-firm relations help to curb opportunistic behaviour by collaboration partners due to its social control. In case of conflicts, skilful managers apply integrative conflict management procedures rather than just compromising or addressing disputes in a distributive manner. Trust develops in both active and passive forms to balance stability and variety within business relationships. Passive trust allows partners to think and act as they learn, while active trust develops the conditions under which learning takes place (Batt and Purchase 2004).

Madhok and Tallman (1998) suggest that relations between organisations have been seen as a productive resource for value-creation and realization. Better performance in the value chain is possible when trading partners are willing to make relation-specific investments and combine resources in unique ways (Asanuma 1989). In summary, the relational governance positively relates to less functional conflict, less stagnation and a desire to resolve disagreements in the process of increasing long term collaboration. Dyer and Singh (1998) argue that a high degree of asset specificity may be a source of competitive advantage if governed through certain types of inter-organisational relations rather than by use of the market mechanism. Despite ample benefits of inter-firm relationships reported in the literature, authors (Larson 1992, Uzzi 1997) argue that development of relational governance involves time and resource-consuming social activities and it may restrict firms to acquire information and search for new opportunities outside the existing collaborative network. As a result, proper caution should be in place before adopting relational governance (Poppo and Zenger 2001).

Similarly, Dyer (1996) argues that specialised supplier network can also create the sources of competitive advantage. Relations between organisations have been seen not simply as a governance structure of a hybrid nature but, more importantly, as a productive resource for value-creation and realization (Madhok and Tallman 1998). Asanuma (1989) suggests that better performance in the value chain is possible when trading partners are willing to make relation-specific investments and combine resources in unique ways.

In this study, relational governance refers to administering the inter-organisational exchange through trust and inter-firm relations. The relational governance actively promotes close personal interaction at multiple levels with the buying firm and engagement on informal basis. It promotes flexibility on contractual terms and conditions while working on collaborative projects as it progresses. Relational governance comprises the informal rules that manage buyer-supplier relationships.

#### **2.4.3 Inter-play of contractual and relational governance**

Despite some contrasting arguments, the literature tends to suggest that contractual and relational governance mechanisms are interrelated and both have important roles to play in collaborative arrangement (Luhmann 1979, Zucker 1986, Larson 1992, Ring and Van de Ven 1994, Poppo and Zenger 2002, Hoetker and Mellewigt 2009, Yuan et al. 2010). The adoption of a particular governance structure depends on the types of exchanges involved between partnering firms (Lee and Cavusgil 2006). Relational governance administers exchanges involving a high degree of asset specificity whereas contractual governance administers low levels of asset specificity. Contractual governance provides clearly articulated contractual terms, remedies and processes of dispute resolution, whereas relational governance promotes trust, relational norms of flexibility, solidarity, bilateralism and continuance (Lee and Cavusgil 2006). For instance, short-term limited transactions may not need complex social processes of relationship development and therefore, a well drafted contract is likely to serve the purpose of mitigating opportunistic behaviour. On the other hand, in the long term many unexpected changes and vast dimensions of exchanges cannot be contractually specified (Poppo and Zenger 2002). In this case, relational governance operates as a self enforcing safeguard that is effective and less costly than contractual governance.

Nevertheless, literature argues that collaboration involves not only the simple transactional exchanges but also helps in creating value for the customer. Hence, collaboration cannot be controlled only by formal contracts and it requires a dense web of interpersonal connections (Kanter 1994). Faems et al. (2006) argue that governance based on relationships lowers transaction costs and facilitates adaptive responses, requiring less effort than formal contractual governance. Subsequently,

Inkpen and Li (1999) argue that establishing a governance mechanism with the necessary flexibility is important for successful collaboration.

Developing a balance between relational and contractual governance and treating them as complements rather than substitutes is a challenge. Although contracts provide a set of mechanisms to avoid risks involved in partnerships, it might not always be possible to draft a *complete contract* due to time and cost constraints. As a result, firms normally design an incomplete contract including some aspect of inter-firm relations to increase the flexibility. Deakin and Wilkinson (1998) discuss that incomplete contracts include non-legally enforceable and poorly specified intentions, promises and conditions for transactions, which offer less certainty but more flexibility in the execution of agreements. Moreover, Anand and Khanna (2000) argue that although collaborations are best described as incomplete contracts, managers have a tendency to cover all potential uncertainties in a written document.

Moreover, empirical study of Lee and Cavusgil (2006) suggests that contracts may serve as the basis or an initiation of a partnership, but it is the relational governance that could leverage alliance performance in its strength, stability and degree of knowledge transfer. Their study also finds the need for future research assessing the influence of governance mechanisms on collaboration structure. Contractual governance may support relational governance by specifying contingencies, adaptive processes and controls (Poppo and Zenger 2002) and relational governance complements contractual governance by generating contractual refinements when change and conflict arise (Macneil 1978). Consequently, inter-play between contractual and relational governance can be described as complex and of a temporal nature. While reviewing extensive literatures in collaboration and governance mechanism, it seems that various forms of collaboration are either governed by contractual, relational or a mix of both. However, most of the collaborative arrangements tend to be dominated by either of the governance mechanism. Degree of intent to protect the intellectual property of the firm, fear of knowledge spill over and benefits of sharing are some of the important factors, which decide which forms of governance mechanism could be more effective in exchange process.

Hoetker and Mellewigt (2009) argue that the comparative effectiveness of contractual and relational governance depends on the amount of physical and knowledge resources present in the exchange process. Physical resources could be effectively exchanged in presence of contractual governance, whereas, knowledge resources in presence of relational governance. Caniels et al. (2012) clearly illustrates the interrelationships between governance mechanisms and their effect on project outcomes. Their findings suggest that relational governance is only beneficial for project outcomes when it is accompanied by contractual control. Further, Fischer et al. (2011) investigate the question whether contractual and relational governance are substitutes or complements, and reveal the existence of dynamic patterns of interaction between the foundation dimension (contract, trust) and the corresponding action dimension (formal control, informal control) of contractual and relational governance. In contrast to previous research, they explain complementary and substitution as the outcome of dynamic interactions between the two governance dimensions. Zheng et al. (2008) analyse the interplay of governance mechanisms and confirm that relational and contractual mechanisms are indeed complementary forms of exchange governance. They further argue that different development characteristics of relational and contractual mechanisms suggest that their dynamic interplay does not follow consistent patterns and concludes with suggestions for more longitudinal studies. Olander et al. (2010) explore the dynamics of relational and contractual governance mechanisms in buyer-supplier collaboration in R&D projects and indicate that both contractual and relational governance mechanisms play a role in buyer–supplier R&D collaboration but their relative importance varies according to the collaboration phase. Both types of mechanisms should be considered simultaneously throughout the collaboration process. Moreover, Mahapatra et al. (2010) also observe that firms deviate from the conventional choices of either transactional or relational governance to a combination of contractual and relational aspects to make the governance structure effective.

The inter-firm governance structure facilitates the effective engagement in the collaborative arrangement. The need of both contractual and relational governance is desired according to the specific form of collaborative arrangement and the skills

and capabilities possessed by the supplier. However, the decision to adopt a particular form of governance structure depends on the balance between safeguarding the capabilities of the firm and the intensity of collaborative engagement. Nature of supplier capability leads the way suppliers integrates with buying organisations and even improves the ability to decide on the mechanism to govern inter-firm market transactions. Suppliers with specific functional capabilities can effectively monitor the progress in the collaboration with buyer and share knowledge with them (Mayer and Salomon 2006). Poppo and Zenger (2002) have examined the complementary and substitutable nature of contractual and relational governance. Literatures like Cannon et al. (2000) and Yu et al. (2006) supports the argument behind the complementarities of contractual and relational governance. Transaction cost economics (TCE) (Williamson 1991) frames governance as a cost minimizing and discriminating alignment between uncertainty and control. As the uncertainty about partner opportunism increases the control provided by different governance form helps to work effectively in collaborative arrangements. Governance forms are efficient when it minimises the combined costs of opportunism and administration arising from uncertainty and asset specialisation (Santoro and McGill 2005).

TCE focuses on the individual transaction as the unit of analysis and demonstrates how the attributes of a transaction influence governance decisions (Mayer and Salomon 2006, Gibbons 2010). Grover and Malhotra (2003) provide the synthesis of TCE, its assumptions, constructs, and propositions in the area of operations and SCM to examine relationships in manufacturing organizations. TCE can provide a valuable lens with which to view and interpret inter-organizational information sharing (Yigitbasioglu 2010). The extent of the contractual hazard in transactional exchange is decided by the degree of asset specificity (Williamson 1985), appropriability (Oxley 1997, Pisano 1990) and observability (Holmstrom, 1979) in an exchange. Asset specificity refers to the transferability of assets to alternative uses (Williamson 1985). When assets are specific to a transaction, they have very little value outside of a given context. In situations where dedicated assets are required, buyer would have the fear that suppliers may behave opportunistically to extract excessive rents from them. Detailed contracts or other safeguards may be used to avoid this fear of holding up the buying firm. However, drafting detailed

contracts and implementing safeguards can be costly and therefore a mix of contractual and relational governance could be the most appropriate for administering the buyer-supplier collaboration. Appropriability refers to contracting hazards that expose valuable intellectual property to expropriation (Gulati and Singh, 1998; Oxley, 1997; Pisano, 1990). When suppliers contract in an external market, they may exchange proprietary information and knowledge. Such an exchange leads to the possibility that the buying firm will expropriate valuable knowledge and may deny the supplier's sole rights to a rent-generating asset. Contracts are limited in their effectiveness at mitigating such expropriation and therefore the relational governance may complement the approach to handle the situations where assets are at risk of misappropriation (Shapiro and Varian, 1999). The observability of the outcomes of transactional exchange is an important exchange hazard (Holmstrom, 1979). When the quality of collaborative output is difficult to observe and measure *ex post*, the contract-based governance can be problematic. Under such conditions, a firm may prefer administrative oversight so as to focus on controlling the input process rather than on metering the output (Holmstrom and Milgrom 1991; Mayer and Nickerson 2005). TCE is a well-established theory to explain inter-firm exchange phenomena. A number of prior literatures (Williamson 1991, Cusumano and Takeishi 1991, Helper 1991 Poppo and Zenger 2002, Lee and Cavusgil 2006, Hoetker and Mellewigt 2009, Li et al. 2010, Yuan et al. 2010) have discussed the importance of TCE in understanding the nature of governance mechanism in inter-firm transaction. Hoetker and Mellewigt (2009) argue that although TCE is greatly overshadowed by the study of contractual governance mechanism, in fact the elements of relational governance have been discussed in the transaction cost framework at the early days of theory development in Williamson (1979). TCE explains the control and coordinating mechanism of governance in collaboration. Therefore TCE is considered as the key theory to explain the governance mechanism in this study.

In summary, the review of the literature indicates that both capability-based view and governance mechanism would be suitable to understand buyer-supplier collaboration (McIvor 2009, Meyer et al. 2009). Jiang (2011) argues that the inter-firm alliance is a complex phenomenon and integrative framework combining the concept of RBV and TCE is required to explain the alliance formation and



management. Moreover, Argyres and Zenger (2012) argue that the RBV and TCE are in fact so intertwined dynamically that treating them as independent in explaining the exchanges beyond firm boundary is fundamentally misleading. They also offer a theoretical synthesis of transaction cost and capabilities approaches to firm boundaries that seeks to overcome each approach's limitations, and provides a unified and logically consistent understanding of boundary decisions. Although previously TCE has offered an acceptable explanation of governance mechanisms in buyer-supplier transactions, it appears to be losing its explanatory power in today's evolving concept of buyer-supplier collaboration (Ghoshal and Moran 1996, Hoyt and Huq 2000). The potential combination of RBV and TCE is desired to explain the relationship between capabilities, governance and collaboration. Although, there are many studies in the area of governance and its influence on joint working mechanism, there are limited studies linking the capability, governance mechanism and collaboration. Hence, it is important to investigate the interaction among internal capability, governance and buyer-supplier collaboration performance from supplier's perspective.

## **2.5 Summary**

This chapter focuses on reviewing previous literatures to capture the research idea, basic themes and relevant theories. The three key themes related to this research are buyer-supplier collaboration, capability-based perspective and governance mechanism. The most common internal capabilities of suppliers are categories as R&D, production, and support-services. Similarly, contractual and relational governance are discussed as the mechanism to administer inter-firm exchange process. Contractual governance signifies the importance of formation of complex contracts, whereas relational governance signifies the importance of building mutual trust and relationships.

This chapter also discusses the capability-based perspective to understand supplier's capability in promoting buyer-supplier cooperation. It is evident in past literatures that internal resources and inter-firm relations both have the ability to generate rents. This study offers insights into the relationship between the capabilities, governance and the type of buyer-supplier collaboration. In practice this will help to establish proper decision regarding alignment of firm internal

capability and governance to effectively collaborate with buying firm. The literature review indicates that collaborative parties should establish well-structured mechanism to blend proper mix of contractual and relational governance to protect their interests and also work together for mutual benefits. The connection between firm specific capability and collaboration success in presence of contractual and relational mechanism for managing inter-firm exchange is crucial. Next chapter discusses the theoretical framework and hypothesised relationships proposed in this research.

## **CHAPTER 3**

### **THEORETICAL FRAMEWORK**

#### **3.1 Introduction**

The chapter introduces the theoretical model developed through this research. A number of hypotheses are presented which explore the relationship between supplier capability, governance mechanisms and buyer-supplier collaboration. The chapter is organised as follows: *Section 3.2* presents the theoretical framework followed by *Section 3.3* which examines the multiple mediation effect of contractual and relational governance on the relationship between supplier R&D capability and buyer-supplier collaboration. *Section 3.4 and 3.5* discuss the effect of contractual and relational governance on the relationship between supplier production capability and support capability with different types of buyer-supplier collaboration (Information sharing, collaborative product development and collaborative problem solving) respectively. Finally, *Section 3.6* summarises this chapter.

#### **3.2 An overview of the theoretical framework**

The primary focus of this study is to investigate the relationship between supplier capabilities, governance mechanisms and buyer-supplier collaboration (BSC). It is asserted that collaboration (operationalized as information sharing, collaborative product development and collaborative problem solving) between buyer and supplier is aided when there is alignment between supplier capability and the governance mechanisms used to coordinate the exchange. Figure 3.1 presents the theoretical model.

Three key functional capabilities of the supplier are examined in the model: R&D, production, and support services capability. These capabilities are considered as the most generic capabilities of the supplier and represent the continuum of the product life cycle (Chen and Chen 2003). They correspond to supplier's ability to get engaged in R&D activities, production activities and provide supporting/complementary services (Jacobides and Winter 2005, Goffin et al. 2006). These three capabilities are widely recognised as the key value adding capabilities found in most of the organisations. The choice of R&D, production and support capabilities is also supported by previous literatures in operations strategy

which have formulated the capability around the common theme of R&D, production and support activities (Boyer 1998, Neely et al. 1995, Noble 1997), and therefore this study considers these capabilities as the focus of this research.

Collaboration builds on the identification of the capability inside the firm boundary and the need to assimilate complementary capability of the other firm. The importance of the supplier capability in buyer-supplier collaboration performance is established in previous studies (Clark and Fujimoto 1991, Liker et al. 1998). Successful collaboration depends on the optimal combination of productive resources/assets across the firm boundary without the fear of over-exploitation (Mitchell et al. 2002, Nickerson and Zenger 2004, Hoetker and Mellewigt 2009). The theoretical model argues that the type of collaboration depends on the supplier capability. This argument is consistent with the studies such as Oh and Rhee (2008) and Goffin et al. (2006), where they have recognised the importance of supplier capabilities in improving the BSC performance. Gulati (1999) also supports the argument that supplier capabilities can influence the level of alliance formation in a supply network environment. Lin and Lin (2009) argue that the economic goal of firms entering alliances is to combine their complementary resources to create synergies. This goal cannot be achieved without allocating value-added activities correctly, establishing efficient inter-organizational routines and introducing proper governance structures.

Building on RBV and TCE, the theoretical model then explores how governance mechanisms can help unlock the value of these supplier capabilities to drive more effective collaboration between buyer and supplier. Argyres and Zenger (2012) argue that RBV and TCE are in fact so intertwined dynamically that treating them as independent in explaining the exchanges beyond firm boundary is fundamentally misleading. They also offer a theoretical synthesis of transaction cost and capabilities approaches to firm boundaries that seeks to overcome each approach's limitations, and provides a unified and logically consistent understanding of boundary decisions. Studies have shown (Poppo and Zenger 2002, Lee and Cavusgil 2006, Liu et al. 2009) that contractual and relational governance function as complements and both are influential in affecting the exchange performance in the collaboration. Further, it is also argued that one cannot take the role of other.

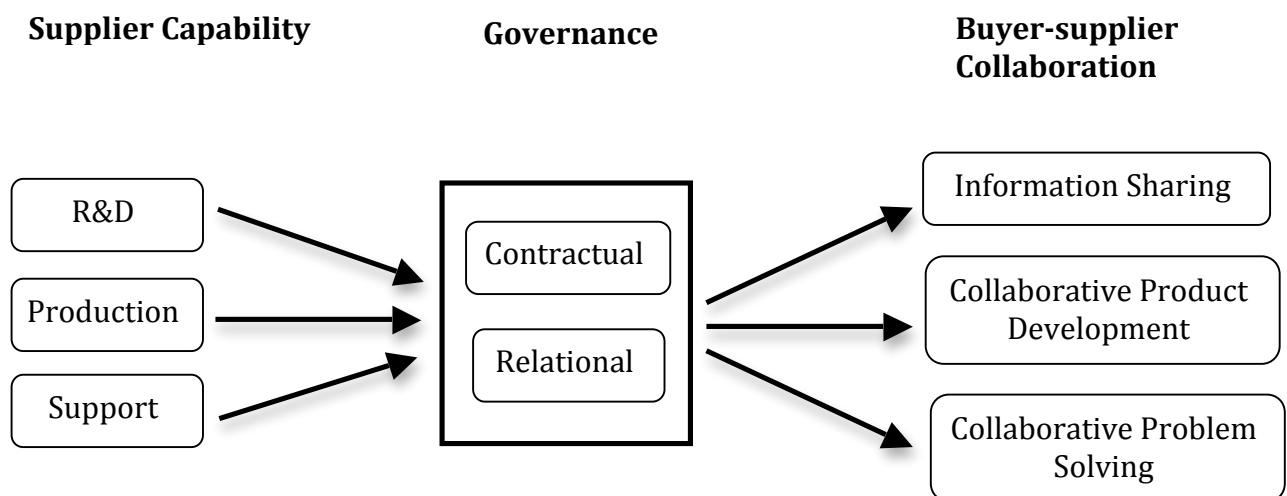
However, the relation between the governance choice and the nature of resources/assets involved in collaboration has found limited attention in the literature (Hoetker and Mellewigt 2009). There is little understanding about the comparative effectiveness of one governance mechanism over other in context of exchange performance in collaboration. This research thus examines the independent effect of both relational and contractual governance on the capability – collaboration relationship. The theoretical model is based on the argument that the effectiveness of contractual and relational governance in the buyer-supplier collaboration is based on the nature of the resources/assets involved in inter-firm transaction. The superiority of one governance mechanism over other in inter-firm transaction depends on the degree of physical assets (which are easy to codify and transmit across the firm boundary) and knowledge assets (which are based on intangible know-how and skills, and difficult to transfer) in the firm capability. This argument is consistent with the study of Hoetker and Mellewigt (2009), which argues that the physical assets are more suited to contractual governance, whereas knowledge assets are best suited to the use of relational governance. They further argue that a misalignment between the governance mechanisms and the nature of the resources/capability can affect the collaboration performance. In this research, the contractual and relational governance are considered as the bridge to link supplier capability with different forms of collaboration. Buyer-supplier collaboration activities involve the exchange of varying degree of extensive resources from both physical and knowledge-based category. Depending on the involvement of physical and knowledge based resources in particular supplier capability, relational governance may improve the collaboration performance for the knowledge based resources but impairs performance for the physical resources (Hoetker and Mellewigt 2009).

The prediction of multiple mediation effect of contractual and relational governance on the relationship between capability and collaboration is based on combining the arguments proposed in previous literatures (Oh and Rhee 2008, Goffin et al. 2006, Hoetker and Mellewigt 2009, Poppo and Zenger 2002, Lee and Cavusgil 2006, Liu et al. 2009, Li et al. 2010) linking the relationships between (a) capability and collaboration, (b) inter-firm exchange and governance mechanism, and (c) the nature of resources and governance mechanism. Previous studies such as, Nielsen (2010) also focuses on mediating effects of different governance

mechanisms on the relationship between conditions for alliance formation and outcome.

Different supplier capabilities such as R&D, production and support contain a varying mix of physical and knowledge based resources. Therefore, it presents different governance problems for inter-firm exchange, which contractual and relational governance mechanisms address with varying degree of effectiveness. Contractual and relational governance mechanisms differ in their ability to support the coordination of inter-firm activities in presence of different capabilities.

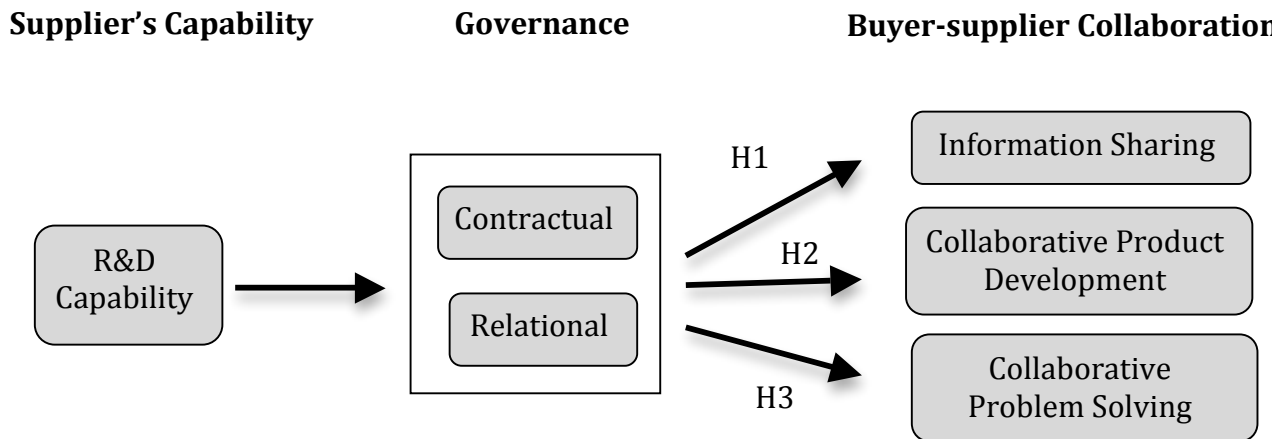
The theoretical model proposes a series of hypothetical relations based on the multiple mediation effects of contractual and relational governance on the relationship between supplier capability and BSC (Information sharing: IS, Collaborative product development: CPD, Collaborative problem solving: CPS). Each of these relationships will now be discussed in detail.



**Figure 3.1:** Theoretical framework

### 3.3 R&D capability and Buyer-supplier collaboration

This section discusses the multiple mediation effect of contractual and relational governance on the relationship between supplier R&D capability and BSC types (IS, CPD and CPS). Figure 3.2 presents the hypothetical relationship between R&D capability and BSC.



**Figure 3.2:** R&D capability and Buyer-supplier collaboration

### 3.3.1 R&D capability and Information Sharing

The information sharing related to product and services between buyers and suppliers is acknowledged as an important aspect of buyer-supplier collaboration. Effective information sharing between buyer and supplier is required to understand market information, reduce supply uncertainty and improve delivery schedule (Humphreys et al. 2004, Dyer 1996). Understanding the impact of supplier's R&D capability on the information sharing is important for improving the collaboration performance with buyer. The impact of governance mechanism on effective information sharing is recognised in previous literature (Zirpoli and Caputo 2002). Moreover, the relation between the type of capability and the governance mechanism (contractual and relational) is also established in the literature (Hoetker and Mellewigt 2009). Oh and Rhee (2008) has established the relationship between supplier capability and buyer – supplier collaboration. Building on previous studies (Oh and Rhee, 2008, Poppo and Zenger, 2002) this study asserts that contractual and relational governance have an important role to play in directing the R&D capabilities of the supplier towards more effective collaboration in the form of information sharing. There is always a concern over the content and extent of the information to share. Decisions over what to share and how much to share are particularly difficult in presence of the capability developed based on the knowledge based resources. Overexposing the resources/capabilities can have an ill effect on the future of the supplier. Suppliers need to safeguard their knowledge to avoid any future disappointment due to over exploitation.

R&D capability is developed based on the knowledge and skills of scientists and engineers of the firm. Although, the contribution of physical resources (Shamsie 1996, Das and Teng 2000) such as buildings, infrastructure, machines etc is required in developing the R&D capability, the knowledge-based resources has more contribution in generating the R&D capability. Some of the researchers define the R&D capability as the ability to create a good or service that meets customer's requirements for functionality, quality, cost and schedule (Pisano 1990, Hoetker 2005). Oh and Rhee (2008) operationalise it as design, engineering and module capabilities. An R&D capability is considered as one of the key assets a supplier can possess that will help to provide competitive edge in the market. Suppliers with strong R&D capability can help to improve the quality of the product/services or the cost of the product/services being offered (Paruchuri and Eisenman 2012). R&D capability is critical in terms of understanding the technological know-how and integrating it at the product end (Pisano 1990). As the nature of R&D capability is knowledge intensive, the first governance issue posed by the exchange of knowledge assets is a variation of the well-known appropriability problem (Oxley 1997). Once the supplier discloses the knowledge to the potential buyer, that buyer is in a position to apply that knowledge without paying for it (Arrow 1962). This situation is difficult to avoid because the potential buyer may not agree to pay for the knowledge until it has the opportunity to evaluate it. This dilemma creates the opportunity to look for an appropriate form of governance mechanism to share information with buyer. This is also consistent with the study of Poppo and Zenger (2001, 2002), which asserts that governance decisions are contingent on the resources involved in the exchange process.

Contractual governance signifies the extent of reliance on formal agreement/contracts, which guide the inter-firm exchange process. It can be seen as the facilitating mechanism to monitor the process of resource and information sharing in collaboration. The contractual agreement can act as an ex-ante mechanism to safeguard against any unwanted behaviour of buyer. Contracts can play a vital role in enabling transactions that require investments in particular assets (Klein et al. 1978). It can impose credible enforceable limits on the actions of buyer and can constrain the its ability to extract additional rents by failing to perform as agreed (Williamson 1985). Buyers and suppliers are often uncertain about their



expectations, goal differences and extent of cooperation in dynamic market situations. Difference in operational routines and cynicism over partner's behaviour in unexpected situation are some of the factors that hamper the performance in information sharing.

The development of R&D capability represents a long-term commitment in terms of resource investment for suppliers. Following this investment it follows that suppliers should seek to protect this intellectual property when collaborating with strategic buyers. The legal protection offered through contractual governance will serve to support the collaboration, offering security for suppliers and engendering information transfer in a more secure contractual environment. Suppliers can use the written contracts embedded in contractual governance as a safeguard against knowledge spill over and thus prevents the exposition of its intellectual property to buying firm.

On the other hand, relational governance refers to the importance of informal interaction in guiding the collaboration process. Relational governance offers an alternative method of protection in the relationship. An R&D capability can be described as knowledge intensive whereby the knowledge is possessed by, and embedded in relationships between engineers and scientists (Hoetker and Mellewigt 2009). We build on this principle in developing the assertion that relational governance can be a very effective mechanism in translating the value of R&D capabilities. Relational governance, as embodied through the social exchange mechanisms of formal and informal socialisation, reciprocation and trust, can serve to not only protect the intellectual capital (Liu et al. 2009) but help to enhance the effect of R&D capability on information sharing between both buyer and supplier. , Previous evidence (Lee and Cavusgil 2006, Lawson et al. 2009) has shown that relational governance fosters confidence in buyer-supplier relationships and encourages actors to engage more actively and openly in collaboration.

Social exchange theory argues that relational governance basically focuses on the social interaction and socially embedded relationship in economic activities. It is also identified as the tool to control opportunism and improve cooperation in buyer-supplier dyad. On the other hand contracts are identified as an important

instrument to monitor buyer-supplier collaboration. Therefore, both contractual and relational governance are expected to undercut opportunism and enhance information sharing.

Relational governance mechanism in collaboration encompasses relational norms and trust. In buyer-supplier dyad, relational norms are related with the behavioural expectations that are partially shared by a group of decision makers and directed towards collective goals (Liu et al. 2009). Moreover, relational norms restrict partners' opportunism through shared norms and values and guide reciprocal exchanges and individual conduct (Brown et al. 2000, Gundlach et al. 1995). Informal engagement between buyer and supplier could help to better understand the supplier R&D capability and look for ways to exchange information acceptable to both buyer and supplier. For such relationally –governed exchanges, the enforcement of obligations, promises and expectations occurs through social processes that promote norms of flexibility and solidarity (Poppo and Zenger 2002), which is important for effective sharing of desired information in the collaboration. Information sharing in an informal and transparent environment is more effective with an increased level of confidence between buyer and supplier. Active involvement maintaining close personal interaction at multiple levels in firm and willingness to share information beyond the contractual agreement promotes greater level of bonding between buyer and supplier which further enhances the quality of information being shared (Dyer 1998).

Literatures argue that contractual and relational governance both are crucial in mitigating risk involved with information sharing and improving the quality of information (Barclay and Brock 1997, Cannon et al. 2000, Poppo and Zenger 2002, Wuyts and Geyskens 2005). Research on inter-firm exchange (Liu *et al.* 2009) maintains that buyer and supplier should employ multiple form of exchange process to guide the collaboration activities. Both contractual and relational governance are important to safeguard against any uncertain eventuality while maintaining the smooth exchange of knowledge and resources.

Knowledge based resources involved in R&D capability are difficult to transfer across firm boundary because they tend to be embedded in the routines and culture

of the firm, composed largely of tacit knowledge and coded in firm's specialised technical language (Spender 1996). Therefore, it is predicted that relational governance may be more effective for exchange of knowledge-based information in buyer-supplier collaboration. Teece (1988) argues that it is much harder to develop concrete criteria for knowledge that one party to supply, specifically if the asset owner is not willing to disclose detailed information about the knowledge.

Relational governance will reduce the fear of opportunism and build up the necessary confidence for supplier with R&D capability to regularly share the information related to product/service, market, process and forecasting. Although formal written legal agreement can inhibit open exchange between buyer and supplier, and therefore, relational will be more effective than contractual governance in information sharing (Ghosal and Moran 1996). When contractual and relational governance mechanism used jointly in buyer-supplier collaboration, researchers anticipate greater benefits than if used separately. The contractual governance may effectively exchange the physical resources associated with the collaboration activity and the relational part of governance will help in effective transfer of knowledge-based resources. However, the knowledge intensive nature of R&D capability indicates that the information sharing will be more effective in case of relational governance. This prediction is consistent with the study of Hoetker and Mellewigt (2009). Based on the above discussion, it is anticipated that:

*Hypothesis 1a: Contractual and relational governance mediate the relationship between supplier R&D capability and information sharing,*

*Hypothesis 1b: Relational governance will be more effective in mediating the R&D capability and information sharing relationship.*

### **3.3.2 R&D capability and Collaborative Product Development**

A supplier with R&D capability helps to promote the development of innovative ideas in anticipation of future market conditions (Mahmood et al. 2011). Collaborative product development (CPD) is an important type of buyer-supplier coordination especially for suppliers who have an ability to link research outputs with current market requirements (Büyüközkan and Arsenyan 2012). CPD activities involve sharing of skills of buyer and supplier to develop new products/services, actively involvement at the early stage of project development

and, share the cost and risks of product development. Given that intensive engagement with buyers may be required at multiple levels it is important to consider how the relationship can be effectively governed to maximise the value of R&D capability on product development. Product development is a knowledge-intensive activity and various forms of knowledge-based resources/assets are exchanged in the CPD activities. The importance of sharing knowledge between buyer and supplier in CPD has been well recognized (Zhen et al. 2011).

The product life cycle is rapidly shortened in today's business environment and therefore new product development has become essential for both growth and survival of organisations. The process of product development is governed by the mechanism, which facilitates effective sharing of knowledge across firm boundary. However, recognising, managing and preventing knowledge loss during the exchange process can be a key determinant of success of the organisation (Shankar 2012). Although, contractual governance mechanism can be effective in protecting the knowledge and intellectual rights, it is hard to design a contract incorporating all the criteria for knowledge exchange in CPD activities. As a result if there is disagreement during the product development stage, it is harder to judge whether or not the knowledge delivered by one party meets the agreed upon criteria (Arrow 1974, Masten 1993). Contractual governance may limit the parties to respond to new knowledge revealed during the process of product development and therefore contractual governance mechanism may not be suitable for coordinating the use of knowledge assets (Hoetker and Mellewigt 2009).

In presence of knowledge intensive capabilities such as R&D, relational governance can facilitate the process of knowledge sharing between supplier and buyer to decide the level of commitments required for jointly developing the products/services. Even in case of uncertain circumstances, both parties can be willing to work out the possible ways to complete the project without holding each other on contractual agreement. Developing a transparent and confident environment for knowledge exchange could not be possible without informal social interaction between buyer and supplier. Lawson et al. (2009) argue that informal socialization mechanisms play an important role in facilitating inter-organizational

knowledge sharing, whereas formal socialization mechanisms act indirectly through informal socialization to influence knowledge sharing. They also report that the interorganizational knowledge sharing is positively associated with supplier contribution to development outcomes, which, in turn, improves buyer product development performance.

Relational governance allows both buyer and supplier to have symmetric information through multiple level of communication, promotes harmonization of conflict and honesty within the exchange process. More buyer and supplier trust each other, more they feel assured that the other firm will cooperate in good faith and care for their collaboration rather than behave opportunistically to exploit the knowledge received from the other party (Dyer and Chu 2003). Rapid technological change adds to the unpredictability for the closer coordination due to the increase in the part complexity and fear for becoming the current technology obsolete sooner (Chen and Paulraj 2004, Hoetker 2005, Petersen *et al.* 2003, Wasti and Liker 1999). It is much harder to develop concrete criteria for knowledge that one party is to supply, particularly in light of the reluctance on disclosing detailed information about the knowledge and sharing the incentives after implementing the knowledge (Gulati et al. 2005). Although both contractual and relational governance mechanisms are important for supplier with R&D capability in order to effectively work on CPD projects without compromising its intellectual property rights (IPR), relational governance may be more effective in achieving the desired success.

Bstieler (2005) argues that in order to reduce risk, time delay and expenses due to increased technological uncertainty, supplier with greater R&D capability will engage in building relationships with buyer to increase its technological proficiency. Buyers are also more interested in adopting relational mechanism for exchange process with suppliers, which have proven capability in R&D activities (Richardson 1996). Once the relationship is built-up between buyer and supplier, they may be reluctant to behave opportunistically even if they recognize the benefits from violating contracts because this can seriously damage the reputation of the focal firm. Technological uncertainty promotes a fair distribution of relational quasi-rent to work towards mutual benefits. In this situation, suppliers

with greater R&D capability can even surrender some of its market power to strengthen the relationship with the buying firm (Asanuma and Kikutani 1992). Kogut (2000) has realised that in case of CPD activities, external suppliers have to give greater importance to share knowledge with the prime manufacturer. Jointly developing a product with buying firm requires sharing the knowledge and idea over a long period of time due to slow diffusion of knowledge across the firm boundary. Sharing innovation related to the product and process design means sharing more tacit information at firm level between buyers and suppliers (Blomqvist and levy 2006) and therefore, in this context relational governance plays a more influential role in guiding the CPD process in presence of R&D capability. In light of the above discussion, it is expected that:

*Hypothesis 2a: Contractual and relational governance mediate the relationship between supplier R&D capability and collaborative product development.*

*Hypothesis 2b: Relational governance will be more effective in mediating the R&D capability and Collaborative product development relationship.*

### **3.3.3 R&D capability and Collaborative Problem Solving**

Collaborative problem solving (CPS) involves activities related to jointly working towards the problems related cost, quality, delivery schedule and uncertain demand patterns of the product and services. Suppliers with greater R&D capability are more specialised in developing the product and services according to market requirement (Lin et al. 2011). However, based on the knowledge gained while working on new product/service development projects, supplier can be willing to collaborate with buyer in problem solving activities if appropriate. This collaboration can be possible in the light of good relationship with buyer based on the past working experience. Relationship built on close personal interaction at multiple levels will promote the nature of helping out the buyer during emergency situations. The informal interaction with the buyer through relational governance provides the ideal environment for improving CPS activities. Sharing the specialist knowledge/skills in short term problem solving activities may not be preferred choice of supplier with R&D capability and therefore, relational governance is important in engaging in CPS activities.

On the other hand contractual governance can serve as an important coordinating role in CPS in terms of incorporating clauses regarding communication of problems related to delivery and maintenance to enable efficient tackling of problem (Gulati and Singh 1998, Mayer and Argyres 2004). It can further enable the predictability of each party's actions when the problem occurs (Gulati et al. 2005). Nevertheless, supplier with R&D capability need to protect its IPR and place proper safeguards against the opportunistic behaviours of buyer. Contractual governance could also be good for controlling the physical assets involved in R&D capability for CPS activities. Contracts are helpful in mitigating the self-interest, and thus the opportunistic behavior, which otherwise seriously undermines the performance of inter-organizational exchanges (Williamson 1996). Formal contracts record the obligations and roles of both buyer and supplier in the collaboration, arrange for enforcement and specify objectives, rules, and procedures for resolving disputes (Cannon and Perreault 1999, Reuer and Ariño, 2002, 2007). By clarifying task and performance expectations, incorporating information provisions and requirements, and instituting penalties for noncompliance, contracts mitigate uncertainty and risks associated with opportunistic behavior. Thus, contracts enhance control and reduce the problem associated with the exchange in BSC (Malhotra and Murnighan 2002). However, the role of formal contracts in knowledge acquisition and sharing is minimal if the resources involved in exchange are knowledge intensive and involved tacit information (Adler 2001, Madhok and Tallman 1998).

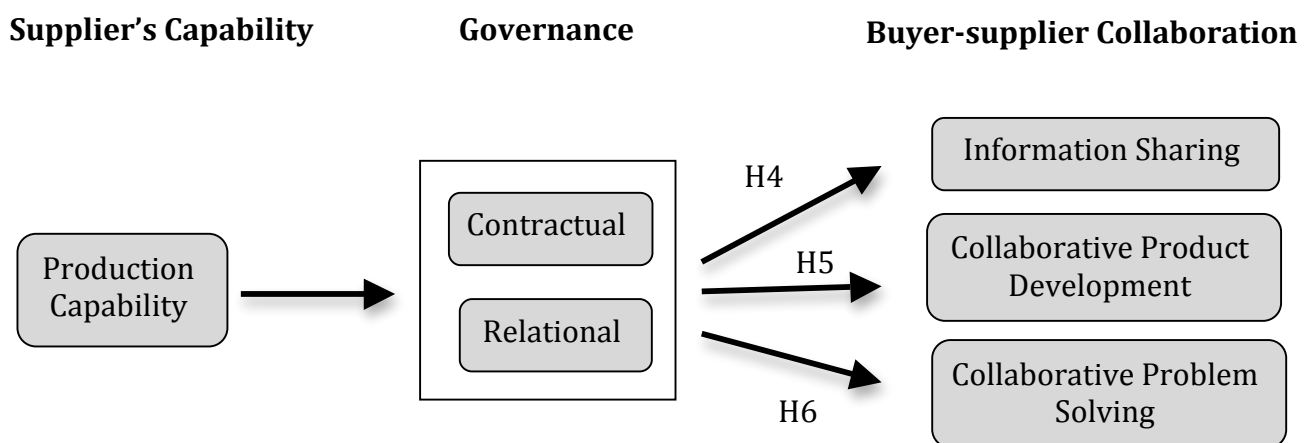
In a collaboration setting where business hazards are severe, the combination of contractual and relational safeguards may deliver greater exchange payoffs than in isolation (Liu et al. 2009). When contractual and relational governance mechanism used jointly in buyer-supplier collaboration, researchers anticipate greater benefits than if used separately. However, relational governance can have more influential when the buyer and supplier are clear about their respective responsibilities in collaborative problem solving activities. Relational governance promotes a bilateral approach to problem solving and creates a commitment to joint action through mutual adjustment (Poppo and Zenger 2002). Relationship based exchange process in buyer-supplier dyad have important value creation properties in the form of efficiency improvement, cost saving and profit enhancement (Liu et al. 2009). With

the development of relational mechanism, buyer and supplier will be better able to formulate their reciprocal expectations and enhance mutual adaptability for CPS. Especially in uncertain situation, this will help to quickly achieve at agreement between buyer and supplier, effectively collaborate on problem solving and accomplish performance targets. Relationship between buyer and supplier encourages adaptation and understanding of each other, and also helps to pool and utilise the resources, talent and skills to jointly solve problems. The contractual governance may effectively exchange the physical resources associated with the collaboration activity and the relational governance will help in effective transfer of knowledge-based resources. However, the knowledge intensive nature of R&D capability indicates that the resource sharing in CPS will be more effective in case of relational governance. This prediction is consistent with the study of Hoetker and Mellewigt (2009). Therefore, it is anticipated that:

*Hypothesis 3a: Contractual and relational governance mediate the relationship between supplier R&D capability and collaborative problem solving.*

*Hypothesis 3b: Relational governance will be more effective in mediating the R&D capability and collaborative problem solving relationship.*

### 3.4 Production capability and Buyer-supplier collaboration



**Figure 3.3:** Production capability and Buyer-supplier collaboration



This section discusses the multiple mediation effect of contractual and relational governance on the relationship between supplier production capability and BSC types. Production capability corresponds to the ability of the firm to provide components or finished products to the buying firm. It is measured in terms of supplier proven ability to consistently offer products according to buyer specifications, to reduce production cycle time, to deliver products on time, to cope with uncertain demand, low rate of product failure due to quality problems and to reduce production cost. The production capability has four components: cost, quality, flexibility and dependability (Neely *et al.* 1995, Noble 1997, Boyer 1998). The role of contractual and relational governance is important in understanding the impact of supplier production capability on BSC. In context of exploring the linkage between supplier production capability and BSC types, the role of both contractual (Mayer and Salomon 2006) and relational governance (Dyer and Singh 1998) is important. Production capability is developed with a mix of physical and knowledge resources/assets, therefore it is anticipated (based on the study of Hoetker and Mellewigt 2009) that a mix of contractual and relational governance will be needed for buyer-supplier exchange process. Although both contractual and relational governance are important in linking supplier production capability with BSC, the relative preference of one over another can differ based on the type of resources (physical or knowledge) involved in the particular collaboration process.

#### **3.4.1 Production capability and Information Sharing**

Suppliers that provide quality products at low cost and at desired time are preferred choice for the buyers (Asanuma 1985, Goffin *et al.* 2006). In current competitive environment, buying firm cannot afford to take risks in collaborating with supplier with weaker production capability. Contractual and relational governance facilitates the exchange process in collaboration in presence of supplier production capability. Formal contracts play a complementary role in knowledge acquisition by enhancing the acquisition of explicit knowledge and further strengthen the effects of relational mechanisms on tacit and explicit knowledge acquisition (Li *et al.* 2010). Suppliers having greater production capability may need to be in frequent consultation with buying firm to understand the nature of the product, the delivery schedule, the urgency of the demand etc. Suppliers having expertise in production

activities will promote frequent information exchange related to product/services such as product design, delivery schedule, product volume etc (Oh and Rhee 2008).

Contractual governance is effective in protecting the information shared by the supplier, but it may also limit the ability of buyer and supplier to respond to new information revealed over the life of the collaboration and may prevent the collaborative partners from pursuing unforeseen opportunities (Masten and Crocker 1985). Contracts encourage explicit information flows through their specific provisions and enforcement. They are necessarily incomplete and cannot specify all types of useful and needed information required to optimize exchange performance. At the inter-firm level, the informal interaction helps to build trust between the parties and eases frequent communication among parties. It is viewed as a critical driver of quality information transfer and willingness to respond quickly to inter-firm request (Inkpen and Tsang 2005, Uzzi 1997, Das and Teng 1998). Close interactions can reveal explicit information gaps, and parties may work together to bridge it. Inter-firm relationship encourages the exchange of contractually unspecified but valuable information. Buyer and supplier can go beyond contractual stipulations because of normative conventions underlying informal relationships, such as feeling obliged to provide accurate, timely information, or norms of reciprocity (McEvily et al. 2003).

Literatures have identified the benefits of sharing real time information with the aim of reducing the inventory cost, production cost, distribution cost and the time to market. Real time information exchange cannot be possible until buyer and supplier build a considerable level of trust to share common decisions without behaving opportunistically. Close personal interaction at multiple levels in both firms is critical to build that confidence. Relational governance facilitates informal communication between buyer and supplier and encourages the supplier to work out joint action plan to deal with buyer's requirements. Frequent information exchange related to product, service and market is crucial in order to provide the goods/services as per their specifications. During production process, the supplier may seek multiple consultations to clarify any confusion or doubts over desired specifications and delivery schedule. Frequency of exchange and degree of information sharing related to products depend on the extent of relational

governance for the exchange process. Under the superior level of relational governance, suppliers will take more initiative in cooperating out of contracts to seize emerging market opportunities (Liu et al. 2009). Informal interaction helps to effectively understand the buyer needs and assist in fulfilling the demand with ease. Even supplier responsiveness to the buyer's demand depends on the degree of information sharing between buyer and supplier. Relational governance norms such as trust may increase the quality and level of information exchange between parties (Tsai and Ghosal 1998). Thus, it is expected that relational governance will have more influential effect on mediating the relationship between supplier production capability and IS.

*Hypothesis 4a: Contractual and relational governance mediate the relationship between supplier production capability and information sharing.*

*Hypothesis 4b: Relational governance will be more effective in mediating the production capability and information sharing relationship.*

### **3.4.2 Production capability and Collaborative product development**

Collaborative product/service development (CPD) process involves sharing the skills/capabilities of both buyers and suppliers to develop new product/services. It also involves working together from the early stage of the project development and sharing the cost and risks associated with the new product development. Prior work shows that the buyer-supplier collaboration or joint ventures are more likely to survive and prosper when parties effectively transfer their managerial, technical, and marketing know-how to each other. (Lane et al. 2001, Steensma and Lyles 2000). CPD is viewed as a long-term commitment to align the resources of both buyer and supplier for new product development. Supplier with production capability can contribute in product development process and can even help in reducing cost and manufacturing cycle of the product. As time to introduce the product in the market is critical for the success of the product, supplier with superior production capability can certainly help the buyer to quickly release the new product in market and cope with uncertain demand pattern. Paiva et al. (2008) argue that the cross-functional activities integrate manufacturing knowledge and contribute to the creation of valuable and rare product characteristics. However, cooperation on new product development demands sharing both the physical and

knowledge based assets/resources, but the degree of requirement of these resources may vary according to the particular project. Therefore, based on the nature of resources exchanged in CPD activities in presence of supplier production capability may need a mix of contractual and relational governance to manage that exchange process.

CPD process involves knowledge sharing across firm boundary. Suppliers with greater production capability can provide an important source of knowledge related to the product design, efficient manufacturing process etc. for new product development. Contractual governance offers a formal framework to make joint decisions, plan collective actions and solve possible conflicts. However, it is likely to be a suboptimal response to transactions involving extensive knowledge assets. The difficulty and cost of negotiating an adequate contract will be higher for knowledge than physical assets and the ultimate utility of the contract in the event of disputes will be lower (Hoetker and Mellewigt 2009). In case of disagreement over the knowledge transfer criteria in collaboration, firms can be forced to return physical resources/assets, but it is difficult to force a firm's employees to unlearn the knowledge once transferred (Arora et al. 2001). Therefore, it is difficult to draft contracts to govern knowledge assets.

A major obstacle to inter-firm knowledge transfer in CPD is the potential leakage of valuable knowledge (Dyer and Singh 1998, Inkpen, 2000). Relational norms such as trust helps overcome this obstacle by establishing a level of behavioral predictability and reliability through the accumulation of exchange experiences (Li et al. 2010). Moreover, trust enables greater cooperation between the recipient and the knowledge source by creating the mutual understanding that both parties will consider the interests of the other (Lane et al. 2001). Trust may foster knowledge transfer in CPD by establishing idiosyncratic sharing routines to facilitate learning of specified information and know-how (Dyer and Singh 1998).

Relational governance will facilitate more open communication between buyer and supplier on product development. CPD is a long term process, which requires a collaborative action plan with the appropriate level of resource commitment and relational governance will be more effective in guiding the resource sharing

process. It is challenging to convince the buyer without having any previous relationship to get involve in the product development at the early stage, when it is tough to decide the future marketability of the product/services. Suppliers having better relationship with the buyers tend to be more actively involved in CPD (Clark and Fujimoto 1991). When relational governance guides BSC, more sensitive information is likely to be shared between buyers and suppliers (Cousins 2002). The repeated interactions across partners that accompanies the use of relational governance mechanism assists in developing the coordinating routines, a common language for discussing technical issues and provide a sense of social cohesion which increases the chance of open exchange of knowledge (Reagans and Mcevely 2003, Hoetker and Mellewigt 2009). In presence of relational governance buyer and supplier can communicate more effectively in the product development process and can be able to deal with unforeseen problems collectively. Therefore, it is anticipated that in presence of relational governance supplier with greater production capability will share the knowledge more effectively. Once the relationship is established, suppliers may provide buyers with cost benefits, invest more in production technology and innovation and prioritize delivery to these buyers.

*Hypothesis 5a: Contractual and relational governance both mediate the relationship between supplier production capability and collaborative product development.*

*Hypothesis 5b: Relational governance will be more effective in mediating the production capability and collaborative product development relationship.*

### **3.4.3 Production capability and Collaborative problem solving**

Collaboratively working on the problems related to product cost, quality, delivery schedule and uncertain demand pattern are challenging in buyer-supplier collaboration. These problems are encountered at different stages of product life cycle and may demand a variable level of resource commitment between partners. Suppliers with production capability can be helpful in supporting the buyers to reduce the production cost, enhance the product quality, improve the delivery schedule and tackle the uncertain demand in market. The nature of physical and knowledge resources involved in the problems solving activity decides the varying

degree of contractual and relational governance in managing the exchange process. Supplier with production capability can be effective in solving the problems encountered during the operation.

Although, contractual governance can offer a legal and institutional framework to guide the responsibilities for problem solving and monitor the ongoing progress, it is impossible to have a complete contract in uncertain market conditions. In this context buyer-supplier relationship is important to get quick response on problems, which may need urgent attention from supplier. Supplier with the skills required to solve these problems can accommodate the buyer's request for help in unforeseen events. Established relationship between buyer and supplier will help to quickly achieve the desired results in CPS. Relational governance mechanisms minimize contracting costs by allowing the parties to move forward with a less fully specified contract under the assumption that contingencies will be addressed in good faith and shirking will not occur (Cusumano 1985). Beyond the mitigation of potential opportunism, a successful inter-firm relationship requires coordination of productive efforts and assets across firms. In addition to their role in governance, the activities associated with relational governance mechanisms also support this coordination in a way that contractual mechanisms do not.

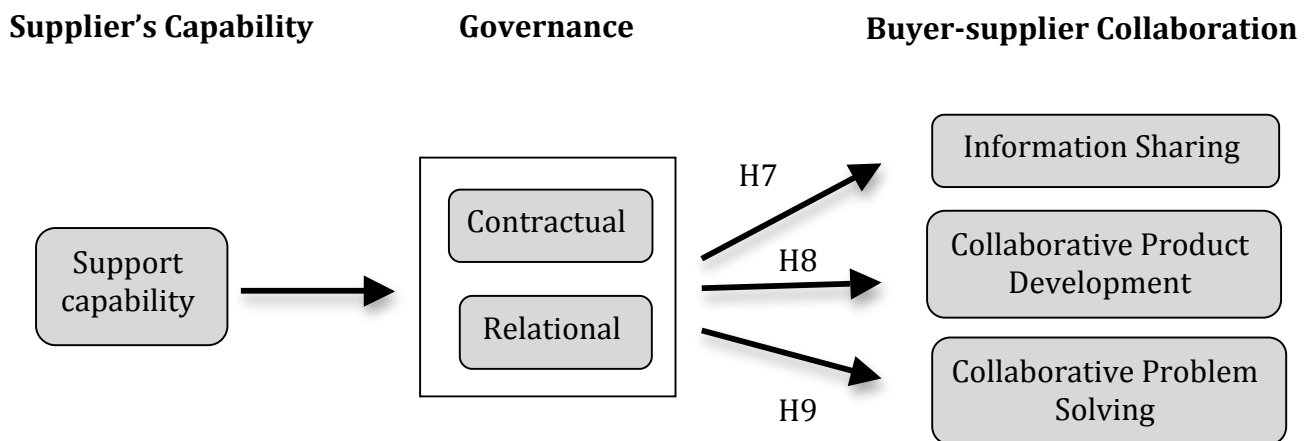
In relational governance environment, resource commitment and incentives sharing in CPS activities can be discussed beyond the contractual agreement if need arises. Buyer can even share the real time demand information to pre-empt the production process at the supplier site to avoid the stock out situation. Suppliers who are involved in producing these products may deal with these problems comparatively easier than the suppliers who do not. Understanding these problems requires multiple consultations with buyer in order to effectively search for potential solutions. On the other hand relational governance mechanism is not automatic because it is not in the interest of both buyer and supplier to behave cooperatively without any guarantee that the other partner will reciprocate the same behaviour (Parkhe 1993). Therefore the relational governance cannot work in isolation and the value of relational governance can be maximised when it is supported by proper contractual agreement such that the individual benefits in collaboration also maximizes the joint payoffs (Liu et al. 2009). However, Relational governance

mechanism offers advantage over contractual governance in coordinating the use of knowledge-based resources in collaboration (Hoetker and Mellewigt 2009). In sum, it is proposed that both contractual and relational governance mediate the relationship between supplier production capability and CPS. However, relational governance will be more effective in establishing the relationship between production capability and CPS. Thus,

*Hypothesis 6a: Contractual and relational governance mediate the relationship between supplier production capability and collaborative problem solving.*

*Hypothesis 6b: Relational governance will be more effective in mediating the production capability and collaborative problem solving relationship.*

### 3.5 Support capability and Buyer-supplier collaboration



**Figure 3.4:** Support capability and Buyer-supplier collaboration

This section discusses the multiple mediation effect of contractual and relational governance on the relationship between supplier support services capability and BSC types. Support services capability refers to the proven ability of firm to provide effective support services related to the product according to buyer's requirements such as maintenance, technical support etc. Reducing the waiting time for support services, consistently provide quality support services at promised time and dealing with the urgent support requests are some of the important parameters of the support services capability (Lai 2004, Parasuraman *et al.* 1994). Support capability is generated with a mix of physical (eg. spare parts, machines etc.) and knowledge resources (eg. technical knowledge etc.) and therefore effective

exchange of these resources depends on the governance mechanism and the type of collaboration activities suppliers engaged in (Hoetker and Mellewigt 2009)

### **3.5.1 Support capability and Information sharing**

There is a growing trend in aerospace industry to provide lifetime support for the products being sold to the customer (buyer). Some suppliers have adopted the price mechanism based on *per hour use* of the product rather than charging the fixed cost. Rolls-Royce has introduced the term, 'power by the hour (PbtH)' which is based on the principle of fixed cost maintenance, and an after-sale fleet support option providing, line maintenance, replacement parts, scheduled and unscheduled engine maintenance, life limited part replacement, incorporation of service bulletin requirements, availability of unit exchange line replaceable units, and continuous spare parts replenishment. The main feature of PbtH is that it undertakes to provide the customer with a fixed engine maintenance cost over an extended period of time. Customers are assured of an accurate cost projection and avoid the costs associated with unscheduled maintenance actions. Lufthansa has also coined the term 'TCM' - total component maintenance) for full maintenance and repair support for the product sold.

The type of information sharing required for the supplier with support capability in collaboration can be categorised into information, which is easy to transmit without the loss of integrity and the information, which is hard to articulate and difficult to transfer (Nonaka and Takeuchi, 1995; Polanyi, 1967, Nobeoka et al. 2002). Different forms of governance mechanism are required to effectively share different types of information. Contractual governance can be more effective in sharing the information, which is easy to codify, whereas relational governance will be more effective in sharing the complex information hard to transfer beyond the boundary of the firm (Li et al. 2010). However, contractual governance is important to decide the domain and boundary of information exchange as agreed by the buyer and supplier together.

Providing customised services to the buyer involve information exchange regarding the operating conditions of the product, life-cycle of the product and potential problems encountered in action (Lai 2004, Parasuraman et al. 1994). Buyers



increasingly prefer suppliers who provide complete solutions for the problems encountered while using the product, especially in the case of high investment products. It has been evident in aerospace industry that buyers cooperate with supplier to get efficient support-services and by doing that buyers avoid the hassles of maintenance and repair in case of malfunctioning of the product. Delivering efficient support services require multiple level of information exchange with buyer.

A strategic relationship is required with the buying firm to get the information about the product/services in long run, so that the supplier could be more responsive to the emergency repairs and maintenance. Superior relation with the buying firm will promote speedy information sharing and will further assist in establishing the synergy in allocation of resources. Relational governance mechanism facilitates open exchange of information to understand the nature of support required and search the effective way to deliver it. Building on greater level of trust, the buyer will have more information about the capability of the suppliers and it will improve the confidence of the buyer that the supplier is able to fulfil the commitments (Kale *et al.* 2000). Therefore, it is anticipated that although contractual and relational both form of governance jointly mediate the relationship between supplier support capability and information sharing with buyer, relational governance has stronger effect in mediation. Therefore,

*Hypothesis 7a: Contractual and relational governance mediate the relationship between supplier support capability and information sharing.*

*Hypothesis 7b: Relational governance will be more effective in mediating the support capability and information sharing relationship.*

### **3.5.2 Support capability and Collaborative product development**

CPD generally involves a greater level of resource commitment between buyer and supplier since the early stage of the product development. It involves the activities related to sharing of resources and skills to jointly develop new products. In the process, buyer and supplier jointly bear the cost and risk of developing the new product. CPD is a long-term commitment between buyer and supplier with a number of ups and downs while progressing on the projects (Hoegl and Wagner 2005). The successful completion of the project depends on the intention of both

parties to make adjustments to cope with unexpected circumstances if need arises. CPD activities involve sharing knowledge intensive resources. Studies demonstrate that factors that influence knowledge acquisition and learning include the use of formal governance mechanism (Inkpen 2008, Lane and Lubatkin 1998, Li et al. 2010), relational mechanisms (Dhanaraj et al. 2004, Szulanski, 1996), and knowledge characteristics such as relatedness, ambiguity, and complexity (Lane et al. 2001, Zander and Kogut 1995).

Contractual and relational governance mechanism responds differently to different forms of resources involved in exchange process in CPD. Activities related with product development need the transfer of both physical and knowledge based resources. Prior studies (Lane and Lubatkin1998) argue that formal controls and procedures generally facilitate the transfer of knowledge, which is easy to codify, however more complex knowledge can be more effectively transferred with the relational governance mechanism. Although, suppliers with support capability may have limited contribution in CPD activities, any skill sharing will be facilitated by informal interactions between buyer and supplier.

As Uzzi (1997) points out that trust is associated with close, intimate relationships and it can build the confidence to share knowledge deeply embedded in the human resources of the firm. Transferring tacit knowledge across organizational boundaries is generally difficult because of its sticky and hard-to-codify nature. Close and intense interactions between exchange partners constitute an effective mechanism to transfer such knowledge. The socialization process greatly encourages the transfer of tacit knowledge (Nonaka and Takeuchi, 1995). The willingness to spend significant time together and maintain stable relationships also facilitates tacit knowledge transfer (Kotabe et al. 2003, Nonaka and Takeuchi, 1995). Therefore, relational governance will be the preferred form of mechanism for the supplier with support capability to engage in CPD activities. If the relationship is stronger, supplier can even go beyond the contractual terms and conditions to help out the buyer. For example, suppliers can send their test engineers to test the product on behalf of the buying firm in their factory. Some of the common examples of support services include maintenance of the product and giving training to the personnel at buying firm to quickly adopt the new technology

or system. For example, if new information system platforms such as ERP etc. are being introduced at buying firm site.

Uncertainty surrounding the market condition results in firms overpaying for the assets when trying to acquire them in the open market (Dierickx & Cool, 1989). When technological uncertainty increases, unanticipated problems involving cost and demand also increase (Auster 1992). Suppliers with greater support capability will have an advantage to cope with these problems. If neither the buyer nor the supplier has the pertinent capability to deal with these situations, the BSC will likely incur greater coordination costs and development delay, which may cause damage to both the supplier and buyer (Oh and Rhee 2008). Trust developed with informal interaction can increase the confidence of both buyer and supplier to work for mutual benefits. As a result, it may reduce the transaction costs associated with the exchange process (Dyer and Singh 1998). While contracts are considered as the safeguards against opportunistic behaviours of partnering firms, it may hamper free and open discussion between firms and so reduces the chances of enhancing the relationship. Inclusion of greater details in a contract and strictly following the contractual guidelines may hold back the firms for working with each other on CPD.

Relational governance mechanism offers advantages over contractual mechanisms in governing and coordinating the use of knowledge assets, therefore more use of relational governance mechanisms is expected when substantial knowledge assets are involved in an alliance (Hoetker and Mellewigt 2009). Although, both contractual and relational governance is important for effective collaborative arrangement (Li et al. 2010), in case of CPD, where the knowledge based resource exchange is more frequent, it is expected that relational governance will be more effective.

*Hypothesis 8a: Contractual and relational governance mediate the relationship between supplier support capability and collaborative product development.*

*Hypothesis 8b: Relational governance will be more effective in mediating the support capability and collaborative product development relationship.*

### **3.5.3 Support capability and Collaborative problem solving**

Problems related to cost and quality of the product/services is tough to predict during the product development stage (Dyer 2000, Cusumano and Takeishi 1991, Hartley 2000, Oh and Rhee 2008). These problems can include frequent change in the cost of the components, low quality products, and delivery failure in mass production stage. Suppliers with expertise in providing support services will prefer to engage in CPS due to the unique nature of their capability. Informal interaction will be certainly useful in CPS in order to understand the capability and skills of each other and build the confidence to work in the collaborative arrangements.

In CPS activities, contracts can specify each party's roles, performance expectations and dispute resolution mechanisms. By placing credibly enforceable limits on the actions of each party, contracts constrain the subsequent ability of one party to extract additional rents from the other by failing to perform as agreed (Williamson 1985). When little is at risk in a relationship, simple contracts will be sufficient to govern the exchange performance in collaboration. In contrast to contractual governance mechanism, the scope of relational governance mechanism is more open and largely based on social interaction (Martinez and Jarillo 1989, Dyer and Singh 1998). These mechanisms enable the parties to resolve conflicts based on open communication and a preference for non-opportunistic win-win solutions (Kale et al. 2000). However, activities involved in relational governance can carry considerable cost in terms of time and resource allocation and therefore firms should invest in the development of relational governance only when significant exchange hazards are present (Larson 1992, Das and Teng 1998, Poppo and Zenger 2002). Although, the mix of contractual and relational governance is required for the effective collaboration performance, the effectiveness of one over another depends on the nature of the resources (Physical or knowledge) involved in the exchange process (Hoetker and Mellewigt 2009).

Understanding the product related problems needs open interaction between engineers of buyer and supplier to reach at an appropriate solution in shorter time period. The problems encountered may be occasional or short-lived and more generic in sense and therefore long-term relationship may not be desired in some

cases. In these cases, due to the sheer short – term nature of business involved in CPS activities, supplier with the expertise in providing support services may prefer to sign the contractual agreement. However, frequently earning the business from the buyer certainly depends on the performance of supplier and working relationship between buyer and supplier. Contractual agreement helps to decide the roles and obligations of each party and provide guidelines for the complaints and disputes during the collaboration. This provides confidence for suppliers that their interests are well protected in the event of exploitation or opportunism.

In the event of CPS, it may be possible that the current supplier with greater support capability is not involved in earlier CPD activities. Due to the expertise in support activities, suppliers can negotiate and renegotiate on the service cost and include the related provisions in the formal agreement. Competition in market creates the fear among the suppliers for potential replacement with new supplier that can provide the support services at further low cost. Signing the long-term contracts with the buying firm helps to minimise the uncertainty over the future business. On the other hand, relational governance can help to build the trust for long-term business and give the confidence to the buyer that this supplier will work for maximizing the joint payoffs and will not walk out in adverse situations. Uncertainty over the buyer's behaviour in competitive environment promotes the negotiation and renegotiation over the terms and condition for collaborative working arrangements. Uncertainty creates problems related to delivery schedule and cost of the products and services, and therefore supplier with greater support capability will be more effective for collaborative problem solving activities.

The repeated interaction with partners that accompanies the use of relational governance mechanisms helps overcome the problems through the development of coordinating routines (Mitchell and Singh 1996, Zollo et al. 2002), a common language for discussing technical issues (Arrow 1974) and a sense of social cohesion increases the open exchange of knowledge (Reagans and Mcevily 2003). Based on the above discussion, it is expected that although both forms of governance (contractual and relational) are needed to engaging in CPS activities for supplier with support capabilities, relational governance will be more effective.

This prediction is consistent with the studies of Das and Teng (1998), Poppo and Zenger (2002) and Hoetker and Mellewigt (2009). Therefore,

*Hypothesis 9a: Contractual and relational governance mediate the relationship between supplier support capability and collaborative problem solving.*

*Hypothesis 9b: Relational governance will be more effective in mediating the support capability and collaborative problem solving relationship.*

### **3.6 Summary**

The chapter has presented the theoretical framework of this research and detailed hypotheses based on the interaction between supplier capability, governance and buyer-supplier collaboration types. In this study, supplier capability is operationalised on the basis of the functional activities such as, R&D, production and support-services. The buyer-supplier exchange governance is considered as contractual and relational governance. Contractual governance signifies the importance of formal contracts to deal with the transactions between buyer and supplier whereas, relational governance stresses on building buyer-supplier relationship. Three forms of BSC are considered for discussion here: IS, CPD and CPS. It is proposed that the contractual and relational governance have multiple mediation effects on the relationship between supplier capabilities and BSC types. However, relational governance is more effective than contractual governance in each capability-collaboration relationship. The next chapter discusses the research methodology adopted for empirical investigation of the hypothetical relationships discussed in this chapter.

## **CHAPTER 4**

### **RESEARCH METHODOLOGY**

#### **4.1 Introduction**

The chapter explains the research methodology adopted in this study and is organised as follows: *Section 4.2* explores the different research philosophies and perspectives in management research; *Section 4.3* outlines the research strategy followed by *section 4.4* which presents the survey design; *Section 4.5* details the data collection techniques used for investigating the research questions in this study; the constructs are operationalised in *Section 4.6*; *Section 4.7* outlines the steps taken to address reliability and validity issues and finally, *section 4.8* summarises the chapter.

#### **4.2 Research philosophy**

Meredith et al. (1989) define a research paradigm as a set of methods that exhibits some pattern or element in common. Research paradigms are also defined as a set of linked assumptions, rules, and perceptions about the world, which is shared by a community of scientists investigating the world (Deshpande, 1983 as cited in Healy and Perry 2000, Gummesson, 2000). Easterby-Smith et al. (2002) describe the importance of philosophical view of the research and argue that it should be understood properly as: (i) it can help to clarify research designs by considering what kind of evidence is required and how it can be gathered and analysed to provide answers to the questions being investigated; (ii) it can also help to recognize the appropriate design and its limitations; and, (iii) it can help to identify, adapt or develop designs that may be outside the researcher's past experience. Philosophical view provides a foundation for the research and it is an important step in the research process (Guba and Lincoln 2005, Denzin and Lincoln 1998, 2000). It guides the method of knowledge development in interpreting the reality.

#### 4.2.1 Classification of different research philosophies

Meredith et al. (1989) highlight two key dimensions that shape the philosophical basis for research activity as *rational/existential* and *natural/artificial*. *Rational/existential* concerns the nature of reality, and whether there is just one reality, which is logical and independent of the researcher, or that reality is subjective and socially constructed. The *natural/artificial* dimension is related to the source and kind of information used in the research.

Literature in management research classifies several philosophical views and describes their characteristics. Easterby-Smith et al. (2002) identify two contrasting views of management research as positivism and social constructionism. Positivism includes the view that social world exists externally and its properties should be measured through objective methods rather than being inferred subjectively. In contrast, social constructionism views reality as socially constructed rather than determined by objective measures and external factors (Watzlawick 1984, Shotter 1993 as cited in Easterby-Smith et al. 2002). However, it is argued that it is not possible to identify any philosopher who subscribes to all aspects of one particular view. Vitale (1985) criticises the exclusive dependence on the positivist model of research and argues that it limits the exploration of methodological alternatives. Moreover, this severely restricts the ability of the researcher to understand the phenomenon being studied and therefore Meredith et al. 1989 argue that methodological pluralism is much more attractive. Some of the other philosophical views discussed in literature are Interpretivism (Orlikowski and Baroudi 1991, Meredith et al. 1989) and critical theory (Meredith et al. 1989, Healy and Perry 2000).

Creswell and Plano Clark (2007) discuss four philosophical views based on the past literatures (Slife and Williams 1995, Lincoln and Guba 2000, Creswell 2003, Guba and Lincoln 2005, Paul 2005) as: post-positivism, constructivism, advocacy and participatory, and pragmatism. *Post positivism* is the alternative research philosophy that moves away from the positivist view and stresses on critical realism. A critical realist believes that there is a reality independent of our thinking about it. It recognises that all observation is fallible and all theories are revisable (Kwan and Tsang 2001, Outhwaite 1987, Cook and Campbell 1979). This research



focuses on the *post-positivism* philosophy to understand and analyse the research problems discussed. The critical realism view is adapted to understand the relationship between supplier's distinct capabilities and its effects on the buyer-supplier collaboration performance. Critical realism holds the view that 'we will only be able to understand and so change the social world if we identify the structures at work that generates those events and discourses' (Bryman and Bell 2007). Easton (1998) also poses arguments against the idea that reality is socially constructed and argues that a critical and objective investigation is required to uncover the reality rather than assuming that it is entirely a social construction. Bhaskar (1975) argues that critical realism refers to understanding the reality based on the pattern of activity of the real life mechanism. Theories, observations and methods are all fallible as reality exists independent of our minds and critical realist believes in accounting the possibility of understanding the true phenomena (Kwan and Tsang 2001). Critical realism believes that the knowledge obtained by observation is considered as real but it is fallible and theory laden (Guba and Lincoln 2005). In summary, critical realism philosophy adopted for this research has two key features as follows (Bryman and Bell 2007): (a) It opposes the view of conceptualization of reality as it directly reflects the reality and argues that it is simply a way of knowing that reality rather than directly reflecting it, and (b) It provides a scope to adopt hypothetical entities that are not directly related to observation but helps to understand the natural settings.

The choice of the philosophical view is justified in terms of the nature of the problem and research methodology adapted in this research. Although, quantitative research methods are used in this research, limited qualitative data is also collected at the initial stage through multiple interviews with the managers in the industry. The primary aim of the interviews was to understand the practical issues and experiences related to suppliers' capabilities, inter-firm governance mechanisms and Buyer-supplier collaboration. The triangulation of data is helpful to avoid the potential bias and sterility of a single method approach (Denzin and Lincoln 2000).

#### **4.2.2 Basic philosophical assumptions**

In this section, assumptions related to the research philosophies are discussed to understand the differences among them. The basic philosophical assumptions are

categorised as ontology, epistemology, axiology and methodology (Easterby-Smith et al. 2002, Creswell 1994, Guba and Lincoln 1988, Creswell and Plano Clark 2007).

*Ontology* is defined as the assumptions that we make about the nature of reality (Easterby-Smith et al. 2002, Creswell and Plano Clark 2007). The key ontological question is '*what is the form and nature of reality and, therefore, what is there that can be known about it?*' *Epistemology* is the general set of assumptions about the best ways of enquiring into the nature of the world (Easterby-Smith et al. 2002). Creswell and Plano Clark (2007) state that it is related to '*how we gain knowledge of what we know*'. It involves the examination of relationship between the researcher and that being researched (Collis and Hussey 2003). The key epistemological questions are '*What is the relationship of the researcher to that being researched and what can be known? Should the researcher remain independent of that being researched in an attempt to control for bias, or should the researcher interact with that being studied?*'

*Axiology* is concerned with the assumptions related to the role of values in the research (Creswell and Plano Clark 2007) where values reflect the personal beliefs and feelings of the researcher (Bryman and Bell 2007). Axiology is related to the process of social enquiry and is greatly influenced by the role played by the researcher in all stages of research process (Collis and Hussey 2003). The key axiological question is '*What is the role of values?*'

*Methodology* is related to the combination of techniques used to enquire into a specific situation (Lincoln and Guba 2000, Easterby-Smith et al. 2002). It focuses on the way knowledge is obtained or investigated. It refers to the approach adopted for the research. The key methodological question is '*What is the process of research?*' In past literatures, two most common research methodologies to relate theory and reality are known as inductive and deductive approaches (Easterby-Smith et al. 2002, Saunders et al. 2007). The inductive approach involves 'theory building' and begins with empirical observation, which leads to identification or development of the theoretical phenomenon (Bryman and Bell 2007). The deductive approach relates to 'theory testing' and is used to derive a set of

hypothesis (or relationships among dependent and independent variables) and test these to prove or disprove the hypothesis. Based on data collected, the theory is accepted, rejected or modified (Easterby-Smith et al. 2002, Saunders et al. 2007, Bryman and Bell 2007). The inductive approach is commonly aligned to the research falling in constructivism/phenomenology paradigm, whereas, a deductive approach can be used to test the observed phenomenon under the positivism/post-positivism paradigm (de Vaus, 2005). This research follows the deductive research methodology to develop the hypotheses related to the relationship between capability, governance and buyer-supplier collaboration type. Table 4.1 summarizes the philosophical assumptions related to post-positivism and constructivism.

**Table 4.1:** Philosophical assumptions related to post-positivism and constructivism (adapted from Creswell and Plano Clark 2007)

<b>Philosophical assumptions</b>	<b>Post-positivism</b>	<b>Constructivism</b>
<b>Ontology</b>	Singular reality (e.g., researchers reject or fail to reject hypotheses)	Multiple realities (e.g., researchers provide quotes to illustrate different perspectives)
<b>Epistemology</b>	Distance and impartiality (e.g., researchers objectively collect data on instruments)	Closeness (e.g., researchers visit participants at their sites to collect data)
<b>Axiology</b>	Unbiased (e.g., researchers use checks to eliminate bias)	Biased (e.g., researchers actively talk about their bias and interpretations)
<b>Methodology</b>	Deductive (e.g., researchers test an a priori theory)	Inductive (e.g., researchers start with participants' views and build up to patterns, theories and generalisations)

### 4.3 Research strategy

Research strategy is defined as the systematic and orderly approach to collecting and analysing data, so that information can be obtained to understand the research problem (Jankowicz 2005). Saunders et al. (2007) propose that research strategy is general planning to answer the research questions. Research strategy depends on

the type of research questions, methodology and research objectives. Bryman and Bell (2007) classify the research strategy based on qualitative and quantitative research. In addition, Saunders et al. (2007) provide some examples of research strategies such as experiments, case study, survey, ethnography, action research and grounded theory. Moreover, Marshall and Rossman (1989) argue that research strategy is different from data collection techniques such as interviewing and participant observation.

Qualitative research involves the constructivism paradigm and focuses on the generation of hypotheses or patterns, whereas quantitative research involves the positivism or post-positivism paradigm and focuses on testing of theory or hypothesis. In qualitative research, the intent is to learn participants' views about a particular phenomenon. However, in quantitative research, the intent is to understand how data provided by participants fits an existing theory i.e. model, framework or explanation. The idea of combining the qualitative and quantitative approaches to address the research problem has been floating in literature and it is argued that combining the two approaches has the potential to capture the benefits of qualitative and quantitative data collection and analysis techniques (Erickson and Kaplan 2000). However, the concerns over excessive resource requirement and time consumption is expressed as two main reasons behind the limited popularity of mixed methods research in management research (Buchanan 1992, Pawson and Tilly 1997). This research uses the survey-based study to investigate the research questions and examine the theoretical phenomenon.

#### **4.3.1 Survey research**

Survey research is one of the common research strategies in management with well-established protocols (Flynn et al. 1990). It involves the collection of data from a population, or some samples drawn from it, to assess the relative incidence, distribution and interrelationships of naturally occurring phenomena. Survey research entails the collection of data on a number of units and usually at a single point in time, with a view to systematically collecting a body of quantifiable data in respect of a number of variables, which are then examined to discern patterns of association (Bryman 1988, Pinsonneault and Kraemer 1993).

Past literature (Forza 2002, Malhotra and Grover 1998, Pinsonneault and Kraemer 1993, Filippini 1997) often classifies survey research in three categories: exploratory, explanatory and descriptive. Exploratory survey research is involved at the early stages of the research when the objective is to gain preliminary insight on a topic; it provides the basis for a more in-depth survey (Malhotra and Grover 1998). On the other hand, explanatory survey takes place when knowledge of a phenomenon is articulated in a theoretical form using well-defined concepts, models and propositions. It aims to find casual relationships among variables and test the adequacy of the concepts developed in relation to the phenomenon (Forza 2002). Descriptive survey research is aimed at understanding the relevance of a certain phenomenon and describing the distribution of it in the population (Dublin 1978, Wacker 1998). Explanatory survey research is the basis of this study to understand the relationship between capability, governance and collaboration. It relies on the structured measurement instrument to collect information. The key phases involved in developing the measurement instrument are identified as: (i) wording (the way questions are asked to collect the information), (ii) scaling (deciding on the scale on which the answers are placed), (iii) respondent identification (identifying appropriate responses for each question) and, (iv) rules of questionnaire design (putting together the questions that facilitate and motivate a response) (Forza 2002).

Survey research has numerous advantages and it is appropriate for data collection to test the proposed hypotheses in this study. Surveys provide a low cost and less time consuming means for measuring different aspects of the research problem. Measures included in the survey can be designed to target specific factors or attributes which may not be directly observable (Boyer and Swink 2008). Data collection and analysis are simpler and easier in the survey as compared to the case study. Participants are not closely involved with the researchers and therefore researcher bias can be minimized in survey research. In most cases, it ensures precision, reliability, standard procedures, and testability (Meredith 1998). Furthermore, survey research may contribute to greater confidence in the generalisability of results (Jick 1979). It has been established as one of the most commonly used research strategies over the last three decades (Malhotra and

Grover 1998, Flynn *et al.*, 1990, Meredith *et al.*, 1989, Meredith, 1998 Forza, 2002, Boyer and Swink, 2008).

Despite having numerous advantages, survey research suffers with a few limitations. It is basically suitable for structured questions rather than general open questions, which undermines the in-depth analysis of the data. Other concerns related to survey research address the difficulties with respondents' interpretations of measures, potential lack of knowledge and representations of the unit of analysis (Boyer and Swink 2008, Easterby-Smith *et al.*, 2002). Gable (1994) argues that often survey research provides only a 'snapshot' of the research issues at a certain point in time and as a result, provides little information on the underlying meaning of the data. Appropriate survey design and information gathering approaches can help to mitigate the risks involved in survey research (Boyer and Swink 2008, Gable 1994). A number of recent studies argue that survey research is the logically established methodology to understand the core issues and problems in the operations and SCM research areas, partly due to its ease of use and less expensive nature (Rungtusanatham *et al.*, 2003; Giunipero *et al.* 2008). Survey research involves cross-sectional examination of numerous firms and therefore it is identified as the method of high external validity (Zikmund 2003).

#### **4.4 Research design**

Research design is the tool that relates the relevant conceptual problem with the practicable empirical research (Ghauri and Gronhaug 2002). It is a blue print of research dealing with at least four problems such as, what questions to study, what data are relevant, what data to collect, and how to analyse the result. Yin (2003) discusses that research design is a logical sequence that connects the empirical data to the study's initial research questions and, ultimately, to its conclusion. Data collection techniques should support the research design to exploit the information required to understand the research problem. In this research, initially a preliminary study is conducted to explore the issues surrounding firm's internal capability, governance and buyer - supplier collaboration in the supply chain. Attewell and Rule (1991) suggest that conducting preliminary study is helpful in getting close to the phenomenon, gathering insights or discoveries about causal links, motivations

and reasons why things happened. It can then be verified by more objective techniques such as the survey.

Initially, qualitative data collection techniques are used to explore the information pertinent to the key themes of this study. The qualitative data collection technique typically involves the information collection through historical archive, participant observations, interviews or questionnaires (Eisenhardt 1989b). However, out of these, interview is one of the most popular data collection techniques in qualitative research.

In the preliminary phase of this research semi-structured interview is conducted on one-to-one basis. *Semi-structured interviews* provide a middle ground between structured and unstructured interviews. They involve more focussed open-ended questions to enable the interviewees to expand on what they consider to be important and to frame those issues in their terms (Burgess 1982, Meredith et al. 1989, Barnes 2001). Although semi-structured interviews provide an opportunity for the researcher to guide the conversation, it also provides the opportunity for the participant to freely express his views on the subject to be studied. Preliminary study involves the implementation of a number of predetermined questions asked in a systematic and consistent manner (Berg 2004). Further, codification of transcripts helps to formulate the key themes emerged. The reliability and validity of the qualitative data are enhanced by a well-designed research protocol (Yin 2003). It contains the procedure and general rules that are used to indicate who and from where different sets of information are to be sought. The core of the protocol is the set of questions to be used in the interview (Voss et al. 2002). The preliminary study helps to understand the real-life perspective of the key phenomenon to be studied in this research. The questions asked during preliminary study to understand the buyer-supplier collaboration in aerospace sector is presented in appendix A.

Questionnaire is one of the most commonly used techniques for data collection in survey research (Fowler 1993, Gable 1994). Questionnaire can be administered personally, by telephone, Internet /web or mailed to the respondent. Questionnaires distributed by mail or email is less expensive to administer than interviews or

telephone conversations and can provide privacy and anonymity to respondents (Easterby-Smith et al. 2002, Saunders et al. 2007, Fowler 1993). It is more time efficient than interviewing, particularly at a distance because once properly designed, the survey can be sent to a large number of people with little extra effort. However, these surveys typically yield numerous unusable or incomplete responses and may require multiple mailings to obtain a high response rate to generalize the data gathered to the whole target population. It is generally agreed that questionnaires are best suited to asking specific rather than general questions, and for closed rather than open questions (Robson 1993, 2002). Questionnaires are designed to ask the questions clearly and it should be concisely presented to minimise the time taken to complete. Presentation and readability are the keys for successful data collection using the questionnaire technique. Long questionnaires affect the response rate and it is hard to maintain the attention till the end of the questionnaire (Forza 2002). Each data collection method has merits as well as shortcomings and the decision to choose a particular data collection technique depends on the need of the specific survey based on the time, cost and resource constraints. This study adopts the questionnaire-based technique to collect the relevant information pertinent to testing the hypotheses related to the relationship between supplier's capability, governance and buyer-supplier collaboration type.

Survey designs may be distinguished as cross-sectional or longitudinal, depending upon whether they exclude or include explicit attention to the time dimension. Cross-sectional design is most appropriate when the aim of the survey is to describe a population and test differences at one point of time (Pinsonneault and Kraemer 1993). In contrast, longitudinal design is appropriate when the aim is to examine and understand the sources and consequences of a dynamic phenomenon that involves change over time. In this research, cross-sectional survey design is used to test the taxonomy or hypothesis developed to generalise the finding in the aerospace industry. Information is collected at one point of time from a number of respondents of the representative sample of the population. In this research perception about the buyer supplier collaboration, relationship and contractual agreement are important. The outcome of this research is dependent on how respondents perceive these behaviours. The survey developed in this research is explanatory in nature and cross-sectional in design. The aim of the data collection



in case of the explanatory survey is to test the hypothesised linkages among the concepts developed in relation to the phenomenon to be studied and of the validity boundary of the models (Forza 2002). Following sections further discuss the different attributes of the survey design process in context of this study.

#### **4.4.1 Unit of analysis**

“The unit of analysis refers to the level of data aggregation during subsequent analysis” (Flynn *et al.* 1990). The theoretical framework developed in chapter 3 is the basis of the unit of the analysis in this research. Flynn *et al.* (1990) argue that the level of analysis is important to understand the focus of the research and the type of data to be collected.

In this research, the unit of analysis is buyer-supplier dyadic collaboration, more specific the collaboration between individual buyer and one of their specific suppliers. It is important to ensure that the level of analysis for data collection and interpreting the results are consistent (Dansereau and Markham 1997, Sanders and Premus 2005). This is critical in interpreting the analysis in the perspective of the theory developed and generalise the findings to the population. Literatures (Robinson 1950, Babbie 1990) suggest that if the unit of analysis for data collection and theory development in a study are different, it will cause methodological and ecological fallacy problems. More discussion of methodological problems associated with the level of analysis can be found in Boyer and Pagel (2000) and O’leary-kelly and Vokurka (1998).

#### **4.4.2 Sampling and Sample size**

Some of the key steps of survey research design involve population selection, sampling, and measurement instrument development. In survey research, *Population* refers to the entire group of people, firms, plants or things that the researcher wishes to investigate. A sample is the subset of the population and it comprises some members selected from the population. ‘*Sampling* is the process of selecting a sufficient number of elements from the population so that by studying the sample, and understanding the properties or the characteristics of the sample objects, the researcher may be able to generalise it to the whole population’ (Forza 2002).. The external validity of the findings improves with more

representative sample. If a sample is not the true representation of the population, sampling errors occur, which excludes the possibility of generalising the results beyond the original sample (Forza 2002).

Sampling techniques can be generally classified in terms of probabilistic and non-probabilistic sampling. In probability sampling the chance of each case being selected from the population is known and is usually equal for all cases, whereas in non-probability sampling the chance of selection is unknown (Saunders et al. 2007). In this study, probability sampling (random sampling) is used from a convenient sample of WEAFF database. Random sampling allows control for the factors like firm size, sales output, which can affect the results. The sample is randomly selected from the member firm database of West of England Aerospace Forum (WEAF) operating in UK aerospace sector. It is considered as the systematic sampling approach and most appropriate for generalising the findings to the population.

Deciding on the *Sample size* is other critical stage in the sampling process. It is associated to the significance level and the statistical power of the test, and further to the size of the relationship to be studied (Malhotra and Grover 1998). Bryman and Bell (2007) argue that the decision about the sample size depends on the compromise between the time and cost constraint and the need for precision. They further argue that in case of random sampling, the bigger the sample the more representative it is likely to be irrespective of the size of the population. Size of the sample is linked with the requirements of the statistical procedures used for measurement quality assessment and hypothesis testing (Forza 2002). As a result, it can affect the validity and reliability of research findings. Literatures (Malhotra and Grover 1998, Forza 2002) suggest that the study must be of adequate size so that the effect to be studied should be statistically recognisable. Some of the literatures argue that the decision on the appropriate sample size is quite subjective and it depends on the objective of the study, the nature of the resources available and the degree of the generalisability required.

In this study the sample of firms is selected randomly from 850 SMEs in the aerospace sector. The sample includes the manufacturing firms, service providers

and firms, which involve in both manufacturing and providing related services. A response rate of 12-15% will be appropriate to generate adequate sample to perform the statistical testing. A number of previous literatures in operations management has selected the sample size more than 100 firms and argues that level of statistical power and confidence required for such studies is acceptable. However, a number of techniques are used in this study to enhance the response rate, which is discussed later in section 4.5.

#### **4.4.3 Selection of potential respondents**

The identification of the potential respondents is important to get the answers of the questions being asked in the survey. A respondent should be one who understands the phenomena being studied and agrees to share the information. In case of questions related to the perception of the person, some form of triangulation such as the use of multiple respondents for the same question are required to reduce the common method/source variance i.e. potentially inflated empirical relationships which can occur when the data have been collected using the same method or have been provided by the same single source (Rungtusanatham *et al.* 2001).

This research is based on questions pertaining to a firm's capability and collaboration with the buying firms. Middle level managers/senior managers are identified as the key respondents in this study as they are expected to be most knowledgeable about the constructs of interest. The anonymity of the responses needs to be maintained during the research process to ensure that the responses are not biased towards portraying a particular image of the firm. In this study, respondents are informed that the responses will be treated with strictest confidence. This helps the respondents to freely express their views without the need to comply with the set of norms they may not see in the real practice. Moreover, multiple respondents are targeted within each firm to increase the validity and reliability of the information being collected (Rungtusanatham *et al.* 2001). In this study the potential respondents are selected with the cooperation of West of England Aerospace Forum (WEAF). WEAF is a regional consortium of the companies operating in the aerospace sector in UK. The response to the questionnaire is a social exchange process and therefore collaborating with

companies and the governing organisations help to get the accurate and reliable information (Dillman 2007).

#### **4.4.4 Pilot study**

Pilot testing is considered as an integral part of questionnaire construction (Flynn *et al.* 1990), necessary to maximise the reliability and validity of the survey and to minimise the measurement errors (De Vaus 2005). Initial semi-structured interviews are conducted with the senior managers of the organisations operating in aerospace sector to understand the real life issues surrounding capabilities, governance and buyer-supplier collaboration. The nature of the questions is open to give the executives the opportunity to speak about the key themes of the research based on their experience. Each interview lasted on average about an hour and half. The interviews helped to understand the theoretical constructs from a practical perspective and informed the survey instrument.

The initial draft of the survey instrument is subjected to the pilot testing to refine/modify the questions, which are not clear to the respondents. The pilot test enables a ‘reality check’ of the questionnaire to ensure that questions are easily understood and the items measure what they are intended to measure (Malhotra and Grover 1998). Pre-testing included respondents from both academia and industry, and included questions regarding the clarity and content of the questions. The objective is to test whether the questionnaire accomplishes the study objectives (Dillman 2007). Flynn (1990) suggests that there is no need to select the respondents randomly for pilot testing, and a convenience sampling is acceptable. It is also important to determine if there is any systematic difference between the way researcher views specific measures and the respondents. The questionnaires are looked at again after the pilot study based on the comments provided by the respondents to ensure the validity and reliability of the measures and make the questionnaire more user-friendly (Fowler 1993).

In this study, a total of eleven pilot test interviews were conducted. Five interviews were conducted with the experts/managers from the aerospace industry and six interviews are conducted with the academicians who have previous experience in conducting empirical studies in operations management. Respondents were asked

to first complete the questionnaire and then answer a set of questions related to the structure of the questionnaire. In this study, pilot testing includes the questions related to design of the questionnaire, the logical sequencing of the questions, language, length of the questionnaire, time taken in completing the questionnaire and any aspect of the question that is objectionable. The questions asked during the pilot testing stage are included in appendix B. Participants are informed about the objective of the pilot testing and asked to critically review the questionnaire. They were asked to identify any aspects of the questionnaire that were unclear, confusing, ambiguous and hard to understand. Participants are asked to give the feedback on every aspect of the questionnaire that can negatively affect the responses to the questionnaire.

#### **4.4.5 Survey layout and administration**

The survey layout and visual clarity of questions are important in improving survey response rates (Dillman 2007). In this study, the questionnaire is divided in 5 key sections followed by the cover letter. Some parts of the questions are written with *bold* font to specify the importance of the particular key words/terms. This makes it convenient to read and record the responses quickly. The cover letter of the questionnaire is included in Appendix C and the survey instrument in Appendix D. The measurement scale used to test the extent of agreement over the particular statement is consistent across the questionnaire. The questionnaire is marked with section headings to improve the ease of navigating and therefore hopefully ensure its completion. The presence of reverse scored questions also keeps the attention high while completing the questionnaire. The layout of the questionnaire is designed to make the respondent comfortable at the start by asking questions pertinent to the organisation background. The questionnaire is divided into following sections; *Section A* – Background information: consists of questions related to the type and size of the organisation, expenditure and sales revenue, and the background information about the respondent like job title and working experience.

*Section B* – Organisation's capability: contains questions related to the core skills and capability of the organisation in the context of R&D capability, support services capability and production capability.

*Section C – Operating environment:* consists of questions related to the perception of the respondents about the nature of the operating environment in the industry. The questions are related to nature of the competition and technological uncertainty in the industry.

*Section D – Collaboration with strategic buyer:* contains questions related to the collaborative arrangements with one of the major buyer of their products/services. Respondents are asked to focus on one of their key strategic buyers while answering the questions in this section. Questions related to the contractual agreement and the relationships with this buyer are included in this section.

*Section E – Collaboration performance:* consists of questions related to the extent of involvement in key collaborative activities such as information sharing, collaborative product/service development and collaborative problem solving.

Dillman (2007) suggests that for an effective survey administration researchers should; (a) make the questionnaire interesting to read, (b) reward the respondent either in terms of showing positive regard or offering tangible awards, (c) eliminate any direct monetary cost to respondents, (d) reduce the physical and mental efforts that are required in completing the questionnaire, (e) Identify the organisations that has legitimacy and build the exchange relationship with them. This study follows the guidelines provided by Dillman (2007) for questionnaire design and survey administration. Each questionnaire is accompanied by a cover letter (Appendix C), which details the aims and objectives of the study, and the potential benefits to the wider academic community and practice. The support of West of England Aerospace Forum (WEAF) was highlighted and logos from both the University of Bath and WEAF served to underline the authenticity of the research. Statements regarding confidentiality of responses were also included in the cover letter to give the confidence to the respondents.

The cover letter clearly states that the respondents will receive a summary report of the findings of the study if they provide their email address at the end of the questionnaire. A lucky draw for the respondents are also planned to improve the response rate. Respondents are informed of this small incentive to show the gratitude towards their time for completing the survey. Apart from that, cover letter also include the statement that a pre-paid envelop is attached with the questionnaire

to ensure that there is no any direct monetary cost associated while responding to questionnaire. 1<sup>st</sup> class postage stamp is affixed with the reply envelop to add importance of quickly getting back the completed questionnaire. This also helps to increase the speed of responses and reduce the survey processing time. Dillman (2007) suggests that if the survey involves any direct cost to the respondents then the response rate will most likely to decline significantly. The approximate time required to complete the questionnaire is communicated with the respondents so that they are aware of the time investment needed. Each questionnaire is personally hand signed by the researcher to give importance to every respondent. The contact details of the researcher are given at the end of the cover letter so that the researcher is easily accessible to the respondents if they have any query or question related to the study.

In this study, mixed mode of surveys is used. The questionnaire is designed in two formats: one for paper based survey and another for web-based survey. This helps to give an option to the respondents who wish to record their responses online. Mailed questionnaires have the following advantages: it can reduce the survey cost, respondents can complete it at their convenience, there is no time constraint, it can ensure anonymity, and it can reduce any potential interference by the researcher. The response rate could be enhanced by sending a reminder to all recipients, with an instruction to disregard it if they have already completed and returned the questionnaire (Flynn 1990). In this study, paper based questionnaire is printed on coloured paper in order to stand out from white paper (Dillman 2007).

Dillman (2007) argues that mixed-mode surveys provide an opportunity to compensate for the weakness of each method such that telephone, face-to-face, web based and postal mode. Although mixing different modes of surveys may raise some difficult issues since there is a possibility that people may give different answers to different mode of surveys, using different mode to prompt the completion of the survey will improve the coverage of the survey and reduce the no response and any potential consequence of this are not apparent (Dillman 2007). The decision of combining two methods to conduct survey should consider the design specific aspects in the first mode that help the second mode to be successful. By introducing a web-based method as a second survey mode, it may be possible to

avoid the potential measurement differences that must be considered for the other mixed mode methods. Evidence exists that people prefer certain modes over another and it is useful to use mixed mode methods to encourage people who have not responded to one mode because they dislike it, may be receptive to a change in approach (Groves and Kahn 1979, Mooney *et al.* 1993 and Petrie *et al.* 1998). In this study the mixed-mode surveys are used to emphasize the importance of the study and increase the response rate.

The West of England Aerospace Forum (WEAF) as sponsor of this research, helped in the distribution of questionnaires to its member companies. Previous studies (Forza 2002) show that prior communication about a survey to potential respondents is helpful in enhancing the response rate, upon distribution. Acknowledging this, information was sent to members of WEAFF through the WEAFF magazine '*Air-Talk*'. This medium was also used to remind respondents about the survey. The paper-based questionnaires along with the cover letter and stamped reply envelope are posted to the WEAFF members in the annual special issue of the '*Air-Talk*'. The cover letter of the questionnaire includes the web address of the online questionnaire for those members who wish to complete it online. To enhance the response rate of the survey the web link of the survey is also posted at the official website of WEAFF with an option to either record the responses online or download a '*word*' copy. The completed '*word*' copy of the questionnaire can be then sent back to the researcher through email or post.

#### *Follow-up email*

In this study, respondents who didn't respond to the questionnaire even after 3 weeks of first sending the questionnaires are reminded by the email. The web-link of the questionnaire and the '*word*' file of the questionnaire both are sent in the follow up email. If requested the paper copy of the questionnaire is also sent to the member. Schaefer and Dillman (1998) explain that sending a follow up email to reinforce the reason for the survey improves the response rate. To increase the response rate in first follow up process, the relevance of the study and the related information about the survey are publicised through WEAFF website and weekly newsletter. This reinforces the legitimacy of the survey and importance of their



responses in the study. The final follow-up email is sent to the WEAFF members two weeks after sending out the first follow-up email.

#### **4.4.6 Handling response bias**

The questionnaire used in this research involved closed end questions and all respondents are given the same set of questions to answer. It eliminates the risk of response bias since each respondent gets the same standard questions based on the similar information. Distribution bias is minimised and the respondent has the freedom to complete the questionnaire at their convenience. Identifying the characteristics of non-respondents is impossible in cases where questionnaires are distributed anonymously (Flynn *et al.* 1990). An alternative method is to check for differences between the first wave of respondents and later returns (Armstrong and Overton 1977, Lambert and Harrington 1990). Non-respondents can limit the generalisability of findings by altering the sample size and therefore a number of techniques are used to enhance the response rate. Late responders are taken to represent assume the characteristics of non-responders. Comparisons of early and later responders are performed using *t-tests*. *T-tests* help to determine if there are statistically significant differences between the two groups of responses. No statistically significant differences among the variables were found in this study suggesting that non-response bias may not be a major concern (Sabherwal 1999).

#### **4.5 Response rate and respondent characteristics**

Participants' responses in this study are collected both through paper and web based questionnaire. The mixed mode method of data collection helps to collect enough responses suitable for the statistical analysis. Questionnaires with missing data significantly reduce the number of usable data for the final statistical analysis to explore the possible relations between the different variables in the study. Flynn *et al.* (1990) reports that research published in the area of operations management are published with response rates as low as 10 – 20 % even with a non respondent bias checked. However, the issue of response rate is a bit trivial in the operations management area and many researchers find it hard to agree on a particular response rate percentage (Malhotra and Grover 1998).

In this study, survey is distributed to 850 member firms of WEAFF that are operating in aerospace industry. Total 132 responses are collected and after further screening, out of those responses only 120 responses are finally used for the statistical analysis. This results in overall response rate of 14.1% for the survey in this study. The response rate achieved in this study is well aligned with the previous empirical studies in operations management (Flynn *et al.* 1990). The respondents represent a range of organisations, including manufacturers, service providers and firms involved in both manufacturing and service providing activities in the aerospace sector. The largest number of responses comes from the manufacturing firms (40%). Service providers represented 34.2% of all responses collected and 25.8% were defined as involved in both manufacturing and service activities. Table 4.2 presents the frequency and percentage of the type of the firms responded.

**Table 4.2:** Type of firms responded

Type of organisation	Frequency	Percentage
1. Manufacturer	48	40.0
2. Service provider	41	34.2
3. Manufacturer – cum - service provider	31	25.8
Total	120	100.0

The size of the firm is measured in terms of the number of employees in that firm. Most of firms responded have less than 50 employees. Out of 120, firms with employees below 50 are 59 (49.2 %). 20% of the firms responded has the size more than 350 employees. Details of the firm size are presented in table 4.3.

**Table 4.3:** Size of the respondent firms

<b>Number of employees</b>	<b>Frequency</b>	<b>Percentage</b>
Below 50	59	49.2
51 - 100	17	14.2
101 - 150	6	5.0
151 - 200	6	5.0
201 - 250	5	4.2
251 – 300	2	1.7
301 – 350	1	0.8
Over 350	24	20.0
Total	120	100.0

The roles of respondents are important to capture the accurate information about the capability of the firm, governance mechanisms and collaboration with the buying firm. Sample of respondents include CEOs/chairmen (8.3%), General managers/managing directors (25%), Business development managers (15.8%), Senior managers (14.2%) and Managers (25%). 14 respondents (11.7%) have the job-titles, which don't come under the above categories. Most of the respondents hold senior positions in their organisations, which is appropriate for this study. The frequency and percentage of respondents' job-titles are presented in table 4.4.

**Table 4.4:** Job-title of respondents

<b>Job-title</b>	<b>Frequency</b>	<b>Percentage</b>
CEO/Chairman	10	8.3
General manager/Managing director	30	25.0
Business development manager	19	15.8
Senior manager	17	14.2
Manager	30	25.0
Other	14	11.7
Total	120	100.0

The working experience of respondents is also important to get the reliable information about the organisation. Respondents with long working experience can effectively comment on the collaborative arrangement with the buying organisation and buyer-supplier relationship. On average most of the respondents have working experience of more than 6 years in current organisation. 75 respondents (62.5%) have the working experience of more than 4 years. Moreover, the number of respondents with working experience of more than 10 years in the current organisation is 54, which constitutes 45 % of the sample.

#### **4.6 Operationalisation of variables**

Transforming the theoretical concepts into observable and measurable elements is one of the critical steps in survey research. The operationalisation process should include the specific observable elements of a construct and information about how it would be observed (Emory and Cooper 1991). Often this process involves a number of problems related to the alignment between theoretical concepts and the empirical measures, the choice between objective and perceptual questions, and the selection of one or more questions for the same construct. Adopting the operational definitions developed, used and tested in previous literatures can overcome these issues (Forza 2002). Literatures such that Malhotra and Grover (1998) and Hensley (1999) suggest that the operational definition of a construct involves people's perceptions about the variables to be measured and it should include multiple elements to efficiently capture the people's perception about the key themes of the research. However, in case of objective constructs, a single direct question would be appropriate. In this study, apart from using the previous literatures to develop the operational measures for constructs, practitioners' perspective of the constructs are also sought to make the scale more robust.

This section discusses the measures of variables presented in the theoretical framework. It is useful to use summated scales whose reliability and validity have already been demonstrated in past (Flynn *et al.* 1990 and Forza 2002). All items used in the questionnaire are measured on the seven point likert scale and most of the questions asked are in terms of the degree of agreement or disagreement over a set of statements (1 represents strongly disagree and 7 represents strongly agree). The support for the use of likert scale in studies in the area of operations

management can be found in a number of literatures (Oh and Rhee 2008). Further, Curkovic et al. (2000) argue that seven point likert scale helps to reduce the attenuation problems encountered by range restriction as compared to five point scale. The following section discusses the measurement scales of independent, dependent and control variables of this study.

### *Independent variables*

One set of independent variable is discussed in the theoretical framework, which comes under the category of *internal capabilities* (R&D capability, production capability and support-services capability).

*R&D capability:* Research and Development (R&D) capability refers to proven ability to involve in research and development (R&D) activities and consistently involve in applying this to enhance the performance of product and services. Measures for R&D capability are adopted from Oh and Rhee (2008) and Coombs and Bierly (2006), and adopted to fit the context of this research. R&D capability is measured on the basis of investment in R&D activities, amount of research outputs, ability to link research output with market requirements and ability to develop new components and products. Respondents are asked to show their level of agreement or disagreement over following six statements regarding R&D capability of the their organisation: (a) We consistently spend on research and development activities; (b) Our research outputs in terms of patents or research papers are consistent; (c) We have proven ability to link research and development activities with market requirement; (d) We have improved our market share due to our research output; (e) We have proven ability to apply our research to enhance the performance of product/services we offer; and, (f) We have proven ability to develop new products/services.

*Production capability:* Production capability refers to firm's proven ability to effectively provide quality product according to buyer specification at promised time and at low cost. Measurement items for production capability are adapted from Oh and Rhee (2008), White (1996) and Fawcett *et al.* (1997). Production capability is measured on the basis of supplier's flexibility, dependability, speed and ability to provide quality products at low cost. Respondents are asked to record

the extent they agree or disagree with a range of statements regarding their ability to produce finished goods or components: (a) We consistently offer the products according to buyer's specifications; (b) We have proven ability to reduce production cycle time; (c) We have proven ability to deliver products on-time; (d) We have proven ability to cope with uncertain demand; (e) We have low rate of product failure due to quality problems; and, (f) We consistently reduce production cost through continuous process improvement.

*Support-services capability:* Support-services capability refers to firm's proven ability to provide support services such as logistics support, IT support, technical support, maintenance and provide training for easy adaption of technology or product/services to buying organisation. It is measured on the basis of supplier proven ability to be flexible, dependable and quick in providing quality support services at promised time. Measures for support services are adapted from Parasuraman *et al.* (1994) and Lai (2004), and fine tuned in context of this study. Respondents are asked to show their level of agreement or disagreement over following six statements: (a) We consistently provide customised support services according to individual buyer's requirements; (b) We have proven ability to reduce waiting time for support services; (c) We have proven ability to provide support services at the promised time; (d) We have proven ability to provide wide ranges of support services such that maintenance, providing training to buyer personnel etc; (e) We have proven ability to deal with urgent support requests from buying firm, such that in-process product failure etc.; and, (f) We have proven ability to consistently provide quality support services.

#### Dependent variables

In the theoretical framework developed, two sets of dependent variables are presented; *First*, the governance mechanisms (contractual and relational) and *second*, buyer supplier collaboration (information sharing, collaborative product development and collaborative problem solving).

*Contractual governance:* Contractual governance refers to the willingness to administer the inter-organisational exchange through written formal agreements or contracts. It shows the intent of the supplier to include the guidelines and possible

action plan of the exchange process in the form of the written agreement while working with the buyer. The items for contractual governance are adapted from Argyres and Mayer (2007), Mesquita and Brush (2008) and Lusch and Brown (1996). A six-item scale examines the design of contract, monitoring of contract and handling the unexpected events in context of buyer – supplier collaboration. Respondents are first asked to choose a key buyer with whom they have been involved in collaborative activities and then describe the level of details they incorporate in the written agreement while working with this key buyer. The scale is anchored from 1-‘*not at all*’ to 7-‘*at a very great extent*’ to measure this construct. Items include; (a) We outline the roles and responsibilities of each party in the formal written agreement; (b) We include the expected collaborative outcomes in the agreement while designing the contract; (c) We specify the procedures in the contract for monitoring the development in collaborative activities; (d) We outline the procedures in the contract for handling the complaints and disputes in collaborative activities; (e) We include the guidelines in the agreement regarding non-compliance and premature termination of the contract; and, (f) We outline the warranty policies in the contract.

*Relational governance:* It refers to the willingness to administer the inter-organisational exchange through trust and inter-firm relations. It shows the intent of the suppliers to involve in building relationship with the buying firm. Measures for relational governance are adapted from Mesquita and Brush (2008), Joshi and Campbell (2003) and Lusch and Brown (1996) and tuned in the context of this research. Measurement scale for relational governance build on items related to close interaction with buyer, informal communication and being flexible. Respondents again are asked to choose the same key buyer with whom they have been involved in collaborative activities and then describe the level of relationship with this buyer. The scale is anchored from 1-‘*not at all*’ to 7-‘*at a very great extent*’ to measure this construct. Eight items are used: (a) We actively promote close personal interaction at multiple levels with the buying firm; (b) We actively engage in informal communication with the buyer to work out the new deal; (c) We are willing to share important private information with the buyer if required beyond the formal agreement; (d) We work out the collaborative action plan based on buyer’s commitment; (e) We would rather make adjustments to cope with

unexpected circumstances than holding each other to the original agreement; (f) We are open to modify the agreement in transparent manner if unexpected events occur; (g) We make an effort to help our buyer during emergencies; and, (h) We are flexible in responding to buyer requests for any change in formal agreement.

*Buyer-supplier collaboration:* The buyer-supplier collaboration is measured on the basis of the degree of information sharing, collaborative product/service development and collaborative problem solving. Measures for different types of collaboration are adapted from Oh and Rhee (2008), and Skjoett-Larsen *et al.* (2003). Respondents are asked, to what extent they agree or disagree with a range of statement regarding the degree of information sharing, collaborative product/service development and collaborative problem solving, considering the same key buyer considered above. Measurement scale for *information sharing* is built on the following five items: (a) We regularly share product/service related information; (b) We regularly exchange price and market related information; (c) We regularly share process related information; (d) We regularly exchange forecasting related information; and, (e) We seldom exchange delivery scheduling information (reverse scored).

*Collaborative product/service development* is measured on the basis of the five items scales developed in previous literatures. Respondents are asked to indicate their level of agreement or disagreement regarding the degree of collaborative product/service development with the key strategic buyer: (a) We share our skills to develop new products/services; (b) We work together from the early stage of project/concept development; (c) We share the cost of new product/service development; (d) We collaboratively take the risk to develop new products/services; and, (e) We seldom work together on new product/service development (reverse scored).

Measurement scale for *collaborative problem solving* is developed on the basis of five items discussed in previous literatures. Respondents are asked to record their level of agreement or disagreement on the following statements: (a) We work together to solve product/service cost related problems; (b) We collaboratively solve quality related problems; (c) We collaboratively solve delivery schedule



related problems; (d) We work together on problems related to uncertain demand pattern; and, (e) We seldom work together on product/service design problems (reverse scored).

#### Control variables

In this study, four control variables are included in the theoretical framework. These control variables can affect the relationship between capability, governance and buyer-supplier collaboration types.

*Size of the firm:* The size of the firm can influence the economies of scale in manufacturing, market power and organisation access to the complementary resources (Venkatraman and Prescott 1990). The effect of firm size is controlled in this study while examining the relationship between capability, governance and buyer – supplier collaboration type. Nooteboom (2004) argues that while a small firm can protect its knowledge from spill over by keeping it more intact inside the boundary, a larger firm finds difficulty to do that. In this study, firm size is measured by the number of employees in the firm.

*Duration of working relationship:* Relationship duration may impact the effectiveness of information sharing, collaborative product/service development and collaborative problem solving in buyer-supplier collaboration (Bucklin and Sengupta 1993, Polonsky *et al.* 2008). The measurement scale of duration of working relationship consists only one item, which asks the respondents about the approximate number of years they have been engaged in the working relationship with the buying firm.

*Type of the firm:* The type of the firm (manufacturer, service provider, manufacturer and service provider both) can influence the relationship between capability, governance and type of buyer-supplier collaboration. Two dummy control variables are used in this study to control the specific impact of the type of the firms on different relationship between independent and dependent variables.

#### **4.7 Reliability and validity**

The reliability and validity of survey instruments are critical issues of concern with this type of research (Meredith et al. 1989, Flynn *et al.* 1990). Reliability indicates dependability, stability, predictability, consistency and accuracy, and refers to the extent to which a measuring procedure yields the same results on repeated trials (Kerlinger 1986, Carmines and Zeller 1979). There are a number of methods available to measure various aspects of reliability. One of the methods to test the reliability is to check whether a high degree of inter-correlation exist among the items that comprise the measure. The most widely accepted measure of internal consistency is Cronbach's Alpha (Cronbach and Meehl 1955). Nunnally (1978) defines Alpha as the average of the correlation coefficient of each item with every other item. Alpha value of 0.70 is generally accepted in management research. However Nunally (1978) even suggest a somewhat lower threshold such as 0.60. In this study, cronbach's alpha is used to evaluate the reliability of the constructs and consistency of the measurement scale. A value of more than 0.70 is acceptable in this study.

Validity refers to the extent that the study explains the phenomenon, which it claims to explain (Flynn *et al.* 1990 and Hair *et al.* 2006). Three key categories of validity are identified as; content validity, predictive validity and construct validity.

*Content validity* is the extent to which the scale truly measures the concept that it is intended to measure based on the content of items. The Delphi method is a very useful means for establishing the content validity of items (Pesch 1989). 'Evaluating the face value of the construct measures i.e. the measure 'on its face' seems like a good translation of the theoretical concept, can indirectly assess its content validity. It is the matter of judgement and must be assessed before data collection' (Rungtusanatham 1998). Content validity can be ensured by informed logical analysis, literature searches and expert opinion.

*Predictive (criterion-related) validity* investigates the empirical relationships between the scores on a test instrument and an objective outcome. Two techniques such as simple correlation and canonical correlation are generally used to examine the predictive validity. The correlation coefficient between the predictor and the

outcome, and obtaining a high value is an indication that the measurement instrument has predictive (criterion related) validity (Flynn *et al.* 1990). “When an instrument is intended to perform a prediction function, validity depends entirely on how well the instrument correlates with what it is intended to predict (a criterion)” (Nunnally 1978).

*Construct validity* measures whether a scale is the appropriate operational definition of a construct. Factor analysis and nomological framework/network can be useful in establishing the construct validity of the survey research (Schwab 1980, Flynn *et al.* 1990). Based on the nomological framework, the hypothesized linkages to other valid constructs can be empirically tested and the definition of the construct would be clarified. The hypotheses should be a logical outgrowth of the proposed linkages illustrated by the framework (Schwab 1980). Factor analysis helps in identifying the items of the construct, and suggests the possible deletion of the items and the places where items should be added. And therefore, helps in establishing construct validity of a previously developed summated scale (Flynn *et al.* 1990).

Internal and external validity are also considered in this study. The measurement scales of different variables in this study are developed from previous literatures. This helps to improve the internal validity of the construct in this study. However, the external validity refers to the generalisability of the findings. Selecting the sample, which is true representation of the population, could ensure this. In this study, ensuring the validity and reliability takes place at various stages in the survey research including prior to data collection, within pilot testing and after data collection for hypothesis testing (Rungtusanatham and Choi 2000). Apart from this, errors in survey research are another area of concern. Forza (2002) identifies four types of error in survey design and suggest that these errors should be minimised. These errors are identified as sampling error, measurement error, statistical conclusion error and internal validity error. Malhotra and Grover (1998) further argue that failure in minimising these four errors can results in wrong conclusion and deviates from contribution to theory testing. A proper identification of the type and nature of information needed for the research can help in overcoming these

errors. In this study all possible measures are considered to minimise the survey errors and maximise the validity and reliability of survey research.

#### **4.8 Summary**

This chapter discusses the research methodology adopted in this study. The research philosophy, research strategy and research design are discussed in context of the research problem addressed in this study. Buyer-supplier collaboration is the unit of analysis in this study. This study adopts the survey based research methodology to investigate the relationship between internal capability, governance and buyer-supplier collaboration. Survey design procedures including sampling, pilot testing, questionnaire design and survey administration are discussed in this chapter. Respondent characteristics and response rate in context of this study are presented along with operationalisation of variables comprising the theoretical model discussed in previous chapter. Issues related to reliability and validity of the research is also outlined.

## **CHAPTER 5**

### **EMPIRICAL ANALYSIS**

#### **5.1 Introduction**

This chapter reports the statistical analysis of the data collected in this research. The statistical analysis is performed with the help of statistical software package ‘*PASW*’ (formerly known as SPSS version 18). The hypotheses developed in Chapter 3 are tested in the perspective of the data collected from various participants in the aerospace industry. Prior to conducting any statistical analysis the data need to be tested for all the conditions (assumptions) for that analysis. These preliminary data preparation process is discussed in *Section 5.2*. *Section 5.3* describes the exploratory factor analysis technique to decide the measurement scales for independent, dependent and control variables. *Section 5.4* examines the bivariate correlations to estimate the possible relations between different variables in this study. The multiple mediation test (or, indirect effect) of contractual and relational governance on the relation between capability and buyer-supplier collaboration type is described in *section 5.5*. At the end, *Section 5.6* summarises the chapter.

#### **5.2 Preliminary data analysis**

Some preliminary data analysis (or data preparation) is usually performed before conducting the tests of hypotheses to acquire knowledge of the characteristics and properties of the collected data (Tabachnick and Fidell 2001, Pallant 2007). This section discusses the preliminary data analysis for data collected in this study. Preliminary data analysis is important in terms of screening the data, examining the normality assumptions, preparing the data for statistical analysis, deciding whether to use parametric or non-parametric testing techniques, getting the feeling for the data and checking the assumptions underlying the statistical tests. Statistical procedures are significantly affected by violation of assumptions and examining the assumption prior to the test is critical in interpreting the final results. It involves examining the central tendencies, dispersions and frequency distributions (Emory and Cooper 1991). Descriptive statistics help to understand the primary characteristics of the data collected.

Data analysis techniques for hypothesis testing can be grouped into two major classes: parametric and non-parametric testing (Forza 2002, Bryman and Bell 2007). Parametric testing techniques are performed on the data derived from interval and ratio measurements when the distribution models are known, and as a result it is considered as a powerful method of analysis. Some of the assumptions for parametric tests are listed as follow: (i) the observations must be independent, that means the selection of any one case should not affect the chances for any other case to be selected in the sample, (ii) it should be drawn from normally distributed populations, (iii) these populations should have equal variance, and (iv) measurement scales should be at appropriate interval so that arithmetic operations can be used with them. Non-parametric tests are normally used with nominal and ordinal data (Hollander and Wolfe 1999) and have fewer and less stringent assumptions. It does not specify homogeneity of variance and normally distributed populations.

#### *Handling missing data*

Although, it is usually assumed that no sample data is missing when statistical models and procedures are used to analyse a random sample, it is rarely the case in practice (Anderson *et al.* 1983). Despite all efforts it is hard to guarantee any survey with no missing data. Tabachnick and Fidell (2001) stress on the importance of the pattern of missing data than the amount of it and suggest to test whether the pattern of missing data is random or not. Missing data can be described as missing completely at random (MCAR), Missing at random (MAR) and not missing at random (NMAR) (Hair *et al.* 2006, Tabachnick and Fidell 2001). MCAR means that the probability of an observation being missing is unrelated to the value of the observed or unobserved variables. In this type of missing data, analysis of only those variables with complete data gives valid and unbiased inferences. With MAR, the probability of an observation being missing is not related to the value of that variable after controlling for another variable. Whilst NMAR means that the probability of an observation being missing is related to the unseen observations themselves. In case of NMAR, the pattern of missing data is non-random, non-ignorable and arises due to the variable in which data is missing.

If the data comes under NMAR category, the generalisability of findings is seriously compromised (Hair *et al.* 2006). In this case the only way to obtain an unbiased estimate of parameters is to model missingness in the model (Dunning and Freedman 2008). Some literatures (Forza 2002) suggest that if the number of cases of missing values is less than 5% of the sample then the observations with missing values could be dropped.

To examine missing data, this study conducted listwise and pairwise deletion of cases or observations from the data set. It is suggested that if there are only a few missing observations, then pairwise deletion would be appropriate. However, in case of many missing observations, listwise deletion would be appropriate (Hair *et al.* 2006 and Howell 2010). Further, Anderson *et al.* (1983) suggest two broad strategies to handle missing data in the survey research: *Deletion* and *estimation* - “When data is missed randomly the estimates resulting from deletion strategy are generally unbiased but less efficient than when no data is missed. The other way is to estimates the missing observation and then proceeds with a statistical analysis of the data set as if it had been completed. The most common procedure for estimating randomly missing values is by expectation maximization (EM), regression or factor analysis performed on the variables”.

A number of techniques are available to estimate missing data such as Maximum Likelihood (ML), Expectation – Maximization (EM), mean value replacement, regression and multiple data imputation (Forza 2002). For the purpose of this study the maximum likelihood technique is discussed, which is also the most commonly used techniques in management research. An Expectation Maximization (EM) analysis is used to estimate the means, correlations and covariance of the missing value. Listwise, pairwise and regression estimation depend on the assumption that the pattern of missing values does not depend on the data values. EM method assumes a distribution for the partially missing data and bases inferences on the maximum likelihood under that distribution. The purpose of multiple imputations is to generate possible values for missing values, thus creating several complete sets of data. Analytic procedures that work with multiple imputation datasets produce output for each complete datasets, plus pooled output that estimates what the results would have been if the original dataset had no missing values.

In this study the data is tested to examine the nature of the missing values. According to Hair *et al.* (2006), a dichotomised correlation technique is useful in checking whether the values are missing completely randomly. Building on this, the observed values in the data are replaced by 1 and the missing value by 0. The correlation technique is applied to each pair of variables in the framework and no significant correlation is found. This suggests that values are missing completely at random (MCAR). Little's chi-square statistic (Little and Rubin 1987) for testing whether values are missing completely at random (MCAR) is suggested by a number of literatures (Howell 2010). In this research, further to verify this results, the data is also subjected to Little's chi square test and the significance level is found as 0.423 ( $p = 0.423$ ) which is greater than 0.05. Therefore the null hypothesis is rejected and it is concluded that the values are missing completely at random.

In this study the item deletion strategy in case of missing values is adopted from Hair *et al.* (2006). For independent variables, if in a particular case no values are observed for 2 or more items on the measurement scale, that case (observation) is deleted and dropped from further statistical analysis. However, in case of dependent variables, any missing items on the measurement scale are resulted in deletion of that observation from further analysis. After following this process, the sample size further reduced from 132 to 124. Missing values in the data are further estimated by the most popular Expectation – Maximization (EM) method. This method is described as the simplest and appropriate for handling missing data (Tabachnick and Fidell 2001). The detailed discussion of EM method and its solutions are provided by Schafer (1999) and Schafer and Olsen (1998).

#### *Treating Outliers*

After testing for missing values in the dataset and further estimating the missing values, the dataset is examined for outliers. Outliers are data that do not fit with the rest of sample data and appear to deviate from other members of the sample. The presence of outliers in the dataset is possible due to any error in data entry, non – treatment of missing values, misrepresentation of the population and presence of any exceptional or abnormal observations in the sample (Tabachnick and Fidell 2001). Outliers can radically alter the outcome of analysis and can also affect the normality assumptions if parametric testing is intended.



Outliers are categorized as: *univariate* and *multivariate*. Univariate outliers are the observations, which are very far from the mean in the data. Normally, it is the case that has an unusual value for a single variable. The Box plot technique is one of the popular techniques to detect outliers. It uses the median and the lower and upper quartiles, normally defined as 25<sup>th</sup> and 75<sup>th</sup> percentiles. A box plot is constructed between the upper and lower quartiles with a solid line drawn across the box to locate the median. One way to identify univariate outliers is to convert all of the scores for a variable to standard scores with a mean of 0 and a standard deviation of 1. Outliers are shown as the numbered cases beyond the rectangle or whiskers, which mark the smallest and largest observations that are not outliers. Normally values above the four standard deviations away from the mean are expected to be outliers and examined in this study (Tabachnick and Fidell 2001). Whether we include or exclude outliers from the data analysis depend on the reason why the case is an outlier and the purpose of the analysis.

Multivariate outliers are different from univariate. It could be present in the dataset when several things for each participant are measured. Univariate outliers are values too far away from the mean whereas multivariate outliers represent a strange pattern of values in the sample data. Multivariate outliers are cases that have an unusual combination of values for a number of variables. The value for any of the individual variable may not be a univariate outlier, but may become outlier in combination with other variables. This is a case, which is not very common and occurs rarely. Detecting multivariate outliers is complex and measurement of Cook's distance and Mahalanobis' distance techniques are recognised as the effective techniques to identify the multivariate outliers. In this study the observations are also examined with the cook's and Mahalanobis' distance method for detecting multivariate outliers, and it is found that the distance was under the limit.

After conducting the analysis for outliers, 4 outliers are identified and they are removed from the sample for any further statistical analysis. The sample size is further reduced to 120 after removing the outliers from the sample.

### *Test for normality assumptions*

The test for whether the pattern of data is normally distributed, is important for deciding between parametric and non-parametric statistical testing for further analysis. In this study, univariate analysis of all the dependent and independent variable are performed to check the normality of the data. The simplest way to test the normality is by visualizing the histogram of frequencies or by looking at the normal probability plot (normal Q – Q plot). In this study, the distribution of raw data for the independent and dependent variables are visualised by plotting the histogram of frequencies and normal probability plots. If the histogram plot matches the bell shaped curve of the normal distribution then it could be reasonably said that the dataset is normally distributed. In this study the histogram plots are not perfectly bell shaped and it seems to be skewed. This inference is also supported by the inspection of the normal probability plots. In these plots, the observed value for each score is plotted against the expected value from the normal distribution. A reasonably straight line could suggest a normal distribution, but in this case, the plots do not have a straight line, which is expected if the data is not normally distributed. The dataset in this study is found to be negatively skewed, where most of the scores are at the high end for the independent and dependent variables.

To address the skewness, based on the transformation recommendation provided by (Tabachnick and Fidell 2001) the raw scores for variables are transformed into the logarithmic scale. Visual inspection of the transformed data confirms a reasonably matching with the bell shaped curve of normal distribution. The normal probability plot further supports this inference. Reasonable straight-line plot for the transformed variables suggest that the transformed score is normally distributed. The box plot test for normality assumption is also conducted to confirm the normal distribution of the data. If most of the rectangle is on one side or the other of the mean line, this indicates the distribution is not normal. No any significant findings are reported which indicate that the distribution is significantly skewed.

The skewness and kurtosis index are other measures for testing the normality distribution of the score. In this study, the skewness and kurtosis index of the transformed score for variables are also examined to test any significant deviations

from the normality. Skewness value provides an indication of the symmetry of distribution. On the other hand, Kurtosis index is the indicator of the peakedness /flatness of a distribution. A value between -1 and +1 is accepted for examining the normal distribution of the score (Hair *et al.* 2006). Table 5.1 shows the skewness and kurtosis index of each variable discussed in this study. It is evident from Table 5.1 that all variables are in the range of -1 to +1 and therefore, the transformed score for variables are not significantly different from normal distribution.

**Table 5.1:**Skewness and Kurtosis index of the variables

Variables	Skewness index	Kurtosis index
R&D capability	-.594	-.758
Production capability	-.087	-.005
Support capability	-.084	-.512
Contractual	-.473	-.417
Relational	-.175	.202
Information sharing	-.476	-.307
Collaboration product/service development	-.696	.264
Collaborative problem solving	-.326	-.746

### 5.3 Exploratory factor analysis

Factor analysis is a statistical technique designed to reduce a large number of inter-correlations among measures to a small number of interpretable dimensions. Conducting a factor analysis on a single summated scale ensures whether all items within the summated scale load on the same construct or whether the summated scale actually measures more than one construct (Flynn *et al.* 1990). There are two main approaches to factor analysis – Exploratory and Confirmatory factor analysis. Exploratory factor analysis (EFA) is often used at the early stage of the research to collect information about the inter-relationships among a set of variables. On the other hand, confirmatory factor analysis (CFA) is often used later in the research process to test or confirm specific theories related to the structure of the set of variables (Pallant 2007). A number of previous literatures have used both types of factor analyses in their research. For example, researchers such that Saraph *et al.* (1989) and Flynn *et al.* (1994) have used exploratory factor analysis (EFA) to

check unidimensionality, while Ahire *et al.* (1996) use confirmatory factor analysis (CFA). However, literatures (Koufteros 1999, Forza 2002) argue that CFA is not a common practice in operations management and it is normally used in testing the separation across measures of different constructs. There is a substantial scepticism about the credibility of using a confirmatory factor analysis (Alwin 2000). It is often argued that if the researcher had the level of confidence necessary to conduct a confirmatory factor analysis, there would have been little need for the research in the first place. When the researcher is less than highly confident about how many factors are necessary and sufficient to describe the data, about which items define which factors, and about the pattern of association among the factors, exploratory factor analysis becomes the technique of preference (Alwin 2000). In this study, EFA is considered as the appropriate technique to explore the nature of measurement items in relation to the set of variables.

There are conflicting views in management research regarding the appropriate level of sample size that is suitable for conducting factor analysis. Some authors suggest that it is not the overall sample size which is of concern. Stevens (1996) suggests that the sample size requirement for factor analysis has been reducing over the years and alternatively, KMO test (Kaiser 1974) of sample adequacy is being conducted more often. In this study the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity (Bartlett 1954) are used to indicate that the factor analysis is appropriate for the variables (Comrey and Lee 1992, Pallant 2007). The KMO measure of sampling adequacy is an index for comparing the magnitude of the observed correlation coefficients to the magnitudes of the partial correlation coefficients. In this study, the KMO index is 0.760 (greater than 0.6) which indicates that the factor analysis is appropriate for the sample in this study (Tabachnick and Fidell 2001). Bartlett's test of sphericity is used to test the null hypothesis that the variables in the population correlation matrix are not correlated. In this study the observed significance level for Bartlett's test is 0.000 ( $p < 0.00$ ), which is small enough to reject the null hypothesis and therefore the factor analysis for the data in this study could satisfactorily proceed.

Factor extraction process involves determining the smallest number of factors that can be used to best represent the inter-relations among the set of variables (Pallant

2007). A number of factor extraction techniques such as Principal component analysis (PCA), unweighted least squares, generalised least squares, maximum likelihood (ML), principal axis factoring, alpha factoring, and image factoring are discussed in the literatures. However, out of these, the principal component and maximum likelihood extraction are the two most popular ones. Costello and Osborne (2005) argue that PCA is not a true method of factor analysis and there is disagreement among statistical theorists about when it should be used, even some argue for severely restricted use of it. A number of researchers such that Floyd and Widaman (1995), Bentler and Kano (1990), and Loehlin (1990) suggest that maximum likelihood is the best choice if data are relatively normally distributed. They have presented the argument that ‘ML allows for the computation of a wide range of indexes of the goodness of fit of the model, and permits statistical significance testing of factor loadings and correlations among factors, and the computation of confidence intervals’. However, if the condition of normality is severely violated, the ‘principal component analysis’ is recommended (Fabrigar *et al.* 1999). In this study as the data set satisfies the normally distributed assumption, the ML extraction technique is adopted for the factor analysis.

Decision on how many factors to retain in factor analysis is critical for further analysis. One of the most commonly used techniques for retaining the factors is the eigen value rule, which states that the eigen value of factors greater than 1.0 should be retained (Tabachnick and Fidell 2001). Other alternative methods for factor retention are scree plot, Velicer’s MAP criteria and parallel analysis (Velicer and Jackson 1990). Costello and Osborne (2005) suggest that scree test is the best choice keeping in mind the simplicity and ease to use. The scree test involves examining the graph of the eigen values and looking for the natural bend or break point in the data where the curve flattens out. The number of data points above the break is usually the number of factors to retain (Costello and Osborne 2005). Tabachnick and Fidell (2001) recommend that an exploratory approach with different numbers of factors should be adopted until a satisfactory solution conforming the theoretical understanding is found. In this study, factors having eigen values greater than one are retained. Scree plot is used to confirm the decision on the number of factors retained.

After the decision over how many factors to retain, the factor rotation technique is used to further simplify and clarify the data structure for interpretation. The rotation methods are grouped under two categories: Orthogonal and Oblique. Varimax, quartimax and equamax are commonly available orthogonal methods of rotation, whereas, direct oblimin, quartimin and promax are oblique rotation methods. Orthogonal rotations produce factors that are uncorrelated, however oblique rotation methods allow the factors to correlate (Tabachnick and Fidell 2001, Hair *et al.* 2006). Costello and Osborne (2005) further argue that using the orthogonal rotation results in a loss of valuable information if the factors are correlated and therefore oblique rotation should be used if factors are not independent of each other. This will theoretically produce a more accurate and perhaps more reproducible solution. In this study the variables in the conceptual framework are not likely to be completely independent with each other and therefore direct oblimin oblique rotation technique (Fabrigar *et al.* 1999) is used.

The magnitudes of the factor loadings are checked to ensure their practical and statistical significance. All the items with loading scores more than 0.4 are extracted and retained for further analysis. Factors are also examined for the ‘crossloading’ items (items that load at 0.32 or higher on two or more factors) (Tabachnick and Fidell 2001). Any item, which is cross-loaded on more than two factors with the loading higher than 0.32 are removed from the further analysis. In the cases where the items are weakly loaded ( $< 0.32$ ) on one factor and highly loaded ( $> 0.50$ ) on other factor, the items are dropped from the factors on which it is weakly loaded (Costello and Osborne 2005). Whenever an item is dropped, the factor analysis process is repeated to investigate that all the retained items are loading on only one factor and there is no any further issue of cross loading.

The results of the factor analysis are presented in Table 5.2. After conducting the maximum likelihood extraction method and the oblique rotation, ten factors are finally extracted. The scree plot confirms the decision to retain 10 factors for the analysis and all of the 10 factors explained a total of 72.07 % of the variance. Eigen values of all the factors extracted are greater than 1. The factor loadings for each item are shown in Table 5.2. Factor loading scores of more than 0.4 are considered as the minimally acceptable score for practical significance (Carmines and Zeller

1990, Costello and Osborne 2005, Hair *et al.* 2006). In this study, all the items retained have the loading score more than 0.4.

#### *Validity and reliability*

All the constructs in the framework are subjected to a systemic assessment to test the validity and reliability. Items of each factor are examined in context of the conceptual framework to determine that the items loaded on the factor are theoretically consistent. No any case of conceptual inconsistency is found. The content validity of each scale was already examined during the pilot study stage.

The internal consistency of the scale is important to ensure that the items that make up the scale ‘hang together’ (Pallant 2007). The internal consistency of variables is examined using reliability analysis of the scale through Cronbach alpha coefficients ranging between 0 and 1. As closer the coefficient is to 1.0 the greater the internal consistency of the items in the scale (Hair *et al.* 2006). George and Mallery (2003) provide the following rules of thumb for the value of Cronbach alpha and strength of reliability:“  $>0.9$  ( Excellent),  $>0.8$ (Good),  $> 0.7$  (Acceptable),  $> 0.6$  (Questionable),  $> 0.5$  (Poor) and  $< 0.5$  (Unacceptable)”. Nunnally (1978) also suggests that the alpha value greater than 0.8 is the indicator that the construct reliability is stronger whereas a value of 0.7 is acceptable. The cronbach’s alpha coefficient of each variable is shown in Table 5.3 - All the variables exceed the 0.7 level.

**Table 5.2:** Factor Analysis

Items	1 R&D	2 Production	3 Support	4 Contractual
Consistent spending on R&D	.760			
Consistent research output	.647			
Ability to link R&D with market	.886			
Improvement in market share due to research output	.855			
Ability to apply research to enhance product/service performance	.733			
Ability to reduce production cycle time		.647		
Ability to deliver products on time		.588		
Ability to cope with uncertain demand		.594		
Low rate of product failure due to quality		.637		
Ability to reduce production cost through continuous improvement		.733		
Consistently provide customised support services			.794	
Ability to reduce waiting time for support services			.801	
Ability to provide support services at the promised time			.778	
Ability to provide wide range of support services			.641	
Ability to deal with urgent support requests			.745	
Ability to provide quality support services			.854	
Outline roles and responsibilities of each party in written agreement				.791
Include expected collaborative outcomes in the written agreement				.753
Specify the procedures for monitoring the development				.810
Outline the procedures for handling the complaints and disputes				.919
Include the guidelines for non-compliance and premature termination				.821

(contd.)



Items	5 Relational	6 Information sharing	7 Collaborative product/service development	8 Collaborative problem solving
Actively involved in close personal interaction at multiple levels	.598			
Actively engage in informal communication to work out the new deal	.630			
Work out the collaborative action plan	.493			
Make adjustments to cope with unexpected circumstances	.834			
Open to modify the agreement in transparent manner	.750			
Make an effort to help during emergencies	.677			
Flexible in responding to requests for any change in the contract	.604			
Regularly share product/service related information		.602		
Regularly exchange price and market related information		.606		
Regularly share process related information		.620		
Share our skills to develop new products/services			.603	
Work together from the early stage of project/concept development			.644	
Share the cost of new product/service development			.433	
Work together to solve product/service cost related problems				.793
Collaboratively solve quality related problems				.845
Collaboratively solve delivery schedule related problems				.704
Work together on problems related to uncertain demand pattern				.634
Seldom work together on product/service design problems (reversed score)				.447

**Table 5.3:** Cronbach's alpha coefficients of variables

Variables	Number of items	Cronbach's alpha
R&D capability	5	.925
Production capability	5	.876
Support capability	6	.920
Contractual	5	.925
Relational	7	.861
Information sharing	3	.807
Collaboration product/service development	3	.817
Collaborative problem solving	5	.833

#### 5.4 Bivariate correlation

Bivariate correlations are used to examine the nature of the relationship between variables in the theoretical framework. Pearson correlation ( $r$ ) is the most commonly used bivariate correlation technique and it measures the association between two quantitative variables without distinction between the independent and dependent variables. The value of pearson correlation coefficients ( $r$ ) exhibits between -1 and +1. Mertler and Vannatta (2005) provide a rule of thumb for interpreting the Pearson correlation value in terms of strength of relationship as: Weak relationship (  $- 0.30 < r < + 0.30$  ) , Moderate relationship (  $- 0.70 < r < - 0.30$  or  $+ 0.30 < r < + 0.70$ ) and strong relationship (  $- 1.0 < r < - 0.70$  or  $+ 0.70 < r < + 1.0$  ) . Malhotra and Grover (1998) suggest that 'r' greater than 0.8 indicates that the variables are highly correlated and it suffers with multicollinearity issues. Table 5.4 shows the pearson correlation values of the bivariate correlation between variables in this study. The entire correlation index is below 0.69, which is under the limit of 0.8 for potential multicollinearity problem.

From table 5.4, it is evident that the R&D capability has a significant moderate relationship ( $r = .49$ ) with the collaborative product/service development, which is expected in the sense that suppliers with greater expertise in R&D tend to engage more in collaborative product/service development with the buying firm. As expected, significant relation is also found between R&D capability and information sharing. R&D capability is negatively correlated ( $r = -.37$ ) with contractual governance and positively related to relational governance ( $r = .17$ ). Support capability is weakly but positively related to the information sharing ( $r =$

.23) and collaborative problem solving ( $r = .22$ ). Moreover, support capability is negatively correlated to the R&D capability ( $r = -.25$ ), but a weak positive correlation is found between support capability and contractual governance ( $r = .22$ ). A weak relationship is evident between production capability and information sharing ( $r = .20$ ). Further, relational governance and support capability are positively related to the production capability with the coefficient index .20 and .49 respectively.

No any significant correlation is found between contractual and relational governance. Different types of collaboration such as information sharing, collaborative product/service development and collaborative problem solving are moderately related to each other. This is expected because all different activities involved in different types of collaboration are not mutually exclusive. This argument is supported by the study conducted by Oh and Rhee (2008). Collaborative product development is moderate to strongly correlated with information sharing ( $r = .69$ ). Similarly, collaborative problem solving has a moderate relationship with information sharing ( $r = .58$ ) and collaborative product development ( $r = .44$ ). All forms of buyer – supplier collaboration are weak to moderately related to both forms of governance i.e. contractual and relational governance. Information sharing has a weak to moderate correlation with contractual ( $r = .25$ ) and relational ( $r = .43$ ) governance respectively. Similarly, collaborative product development is positively related to contractual ( $r = .25$ ) and relational ( $r = .37$ ) governance. In addition, collaborative problem solving is found to be moderately correlated to the contractual ( $r = .32$ ) and relational governance ( $r = .35$ ). Table 5.4 represents the Pearson index of different bivariate correlation

**Table 5.4:** Correlation matrix (Pearson Correlation index)

<b>Variables</b>	<b>Mean</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>	<b>11</b>	<b>12</b>
<b>1</b> Contractual	4.53	1.00											
<b>2</b> Relational	5.80	.09	1.00										
<b>3</b> Information sharing	5.02	.25**	.43**	1.00									
<b>4</b> Collaborative product develop	4.90	.25**	.37**	.69**	1.00								
<b>5</b> Collaborative problem solving	5.48	.32**	.35**	.58**	.44**	1.00							
<b>6</b> R&D capability	4.62	-.37**	.17*	.14*	.49**	.13*	1.00						
<b>7</b> Support Capability	5.24	.22*	.09	.23*	.14*	.22*	-.25**	1.00					
<b>8</b> Production capability	5.45	.06	.20*	.20*	.13*	.19*	-.04	.49**	1.00				
<b>9</b> Firm size	3.09	-.46**	-.01	-.06	-.10	-.04	.37**	-.10	.11	1.00			
<b>10</b> Relationship duration	3.85	-.11	.12	.10	.10	.12	.00	-.01	-.12	.09	1.00		
<b>11</b> Firm – manufacturer	.40	.20*	.13	.10	.07	.02	-.17	.01	-.11	-.02	.12	1.00	
<b>12</b> Firm – Service provider	.34	-.19*	-.13	-.09	-.10	.08	-.06	.04	.15	-.10	-.28**	-.59**	1.00

\*\* Correlation is significant at the 0.01 level (2-tailed) ( $p < 0.01$ ).

\*Correlation is significant at the 0.05 level (2-tailed) ( $p < 0.05$ ).

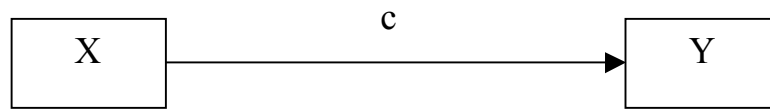
## 5.5 Multiple mediation effect

This section discusses the statistical testing procedure for the multiple mediation effect of contractual and relational governance on the relation between supplier capability and type of the buyer-supplier collaboration. The hypotheses proposed in Chapter 3 are also investigated in this section.

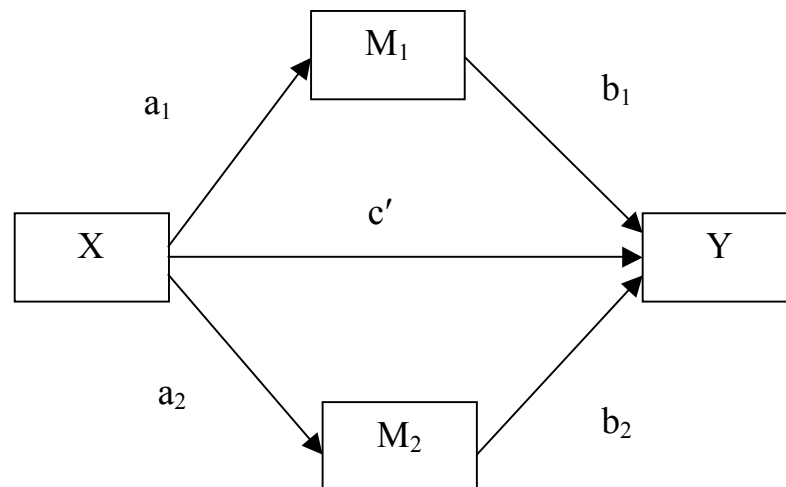
‘Mediation or an indirect effect is said to occur when the causal effect of an independent variable (X) on a dependent variable (Y) is transmitted by a mediator (M). In other words, X affects Y because X affects M, and M, in turn, affects Y’ (Preacher *et al.* 2007). Baron and Kenny (1986) explain that a variable may be called a mediator to the extent that it accounts for the relation between the predictor and the criterion. Mediation effect and indirect effect are often used interchangeably. However, Holmbeck (1997) argues that the mediation effect is usually thought as the special case of indirect effects when there is only one intervening variable. The mediation effect suffers with the assumption that the ‘total effect’ from X to Y needs to be present. However, in the assessment of indirect effects, it is quite possible to find that an indirect effect is significant even when there is no evidence for a significant total effect (Preacher and Hayes 2004). In this study, contractual and relational governance are hypothesised as mediating variables. It is expected that the effect of supplier capability on type of buyer–supplier collaboration be transmitted via (mediated by) contractual and relational governance.

Figure 5.1 explains the total effect, direct effect and indirect effects in the case of an independent variable X, dependent variable Y and two mediating variables  $M_1$  and  $M_2$ . X’s total effect on Y is denoted as ‘c’. This total effect interpreted as the expected amount by which two cases that differ by one unit on X are expected to differ on Y. This direct effect can be the combination of the other indirect effects (Hayes 2009). In figure 5.1 (b)  $a_1$  is the coefficient for X in the model predicting  $M_1$  from X, and  $b_1$  is the coefficient in the model predicting Y from  $M_1$ . Similarly,  $a_2$  is the coefficient for X in the model predicting  $M_2$  from X, and  $b_2$  is the coefficient in the model predicting Y from  $M_2$ .  $c'$  is the coefficient in the model predicting Y from X. In the language of path analysis,  $c'$  quantifies the direct effect of X whereas the product of  $a_1$  and  $b_1$  quantifies the specific indirect effect of X on

Y through  $M_1$  and the product of  $a_2$  and  $b_2$  quantifies the specific indirect effect of X on Y through  $M_2$ . The indirect effect is interpreted as the amount by which two cases who differ by one unit on X are expected to differ on Y through X's effect on the mediator variables, which in turn affects Y. The direct effect is interpreted as the part of the total effect of X on Y that is independent of the pathway through  $M_1$  and  $M_2$ . In the multiple mediation model in figure 5.1 (b), the total effect is equal to the direct effect of X on Y plus the sum of the indirect effect through  $M_1$  and  $M_2$  and it could be represented as,  $c = c' + a_1b_1 + a_2b_2$ . the total indirect effect is the sum of the specific indirect effects i.e.  $a_1b_1 + a_2b_2$  (Hayes 2009, Brown 1997).



(a) Direct effect



(b) Multiple Mediation effect

**Figure 5.1:** A multiple mediation model (a) Illustration of a direct effect (b) Illustration of a multiple mediation effect (adopted from Preacher and Hayes 2008a).

Although, causal steps approach, proposed by Baron and Kenny (1986) is one of the most widely used method for testing hypotheses about intervening variables effects, it has been often criticized heavily on multiple grounds (Zhao et al. 2010).

Previous simulation studies (Fritz and MacKinnon 2007, MacKinnon *et al.* 2002) conclude that the causal steps approach is weakest among the methods for testing intervening variable effects and it is not favourable to use for detecting the intervening effects. Another criticism of the causal approach is that it is not based on the quantification of the very thing it is attempting to test i.e. the intervening effect. The existence of an indirect effect is tested logically by the outcome of a set of hypothesis tests. Hayes (2009) argues that the inferences about the indirect effects should be based on the product of its quantified constituents parts (i.e. based on the values of  $a$ 's and  $b$ 's of the mediation model). He further argues that it makes more sense to minimize the number of tests one must conduct to support a claim and therefore, the causal steps approach is not the most appropriate approach for the intervening variables tests.

### **5.5.1 Bootstrapping**

Modern approaches to test intervening variable effects that are based on the product of the coefficients are Sobel test (Sobel 1982, 1986) and bootstrapping (Lockwood and MacKinnon 1998). It is suggested that the sobel test also has its flaws. *First*, it is based on the assumption that the sampling distribution of the indirect effects should be normal, but in practice, the sampling distribution of products of the coefficients (i.e.  $a_1b_1$  or  $a_2b_2$ ) tends to be asymmetric with non zero values for skewness and kurtosis index (Bollen and Stine 1990, Stone and Sobel 1990). *Second*, Sobel test assumptions are less likely to be satisfied for small to moderated sized samples (Preacher and Hayes 2008b). *Third*, in contrast to the Sobel test, bootstrapping doesn't use the standard error to interpret the results and avoids the controversy behind estimating the standard errors of the indirect effect.

It is acknowledged that the bootstrapping doesn't assume normality for the sampling distribution and are known to be more powerful than the sobel test (Hayes 2009). Previous empirical research (Fritz and MacKinnon 2007, MacKinnon *et al.* 2002, MacKinnon *et al.* 2004) shows that bootstrapping tends to have greater power and is more appropriate for controlling statistical errors. It is also argued that bootstrapping can produce more accurate results in case of mediation analysis and should be used for estimating and testing hypotheses related to mediation effect (Efron Tibshirani 1998, Good 2001, Lunneborg 2000, Mooney

and Duval 1993, Rodgers 1999, Bollen and Stine 1990, Lockwood and MacKinnon 1998). In this study bootstrapping technique is used to test the hypothesised multiple mediation / indirect effects of contractual and relational governance on the relationship between capability and collaboration.

The bootstrapping process involves an empirical representation of the sampling distribution of the indirect effects (i.e. product of the *a* and *b* paths) by taking a new sample from the available sample and estimating the indirect effects (Preacher and Hayes 2008b). The bootstrapping process yields a percentile-based bootstrap confidence interval. However, more accurate confidence intervals can be derived through the process of bias correction or bias correction and acceleration (Stine 1989, Lunneborg 2000, Preacher and Hayes 2008a, MacKinnon *et al.* 2004). In this study the bias correction confidence interval is used. The null hypothesis of no indirect effects is examined by determining whether zero is between the lower and upper bound of the confidence interval. The indirect effect exists if zero is not inside the confidence interval. Literatures such as MacKinnon *et al.* (2004), Hayes (2009), and Williams and MacKinnon (2008) conclude that the bootstrapping is more robust than the Sobel test and the causal steps method to test intervening variable effects. In this research, the multiple mediation macros created and validated by Preacher and Hayes (2008a) for SPSS/PASW are used to test the indirect effects of governance on the relationship between capability and collaboration. These macros have been effectively used in a number of previous studies (Roelofs *et al.* 2008, Danaher *et al.* 2008, Buffardi and Campbell 2008, Ruva and McEvoy 2008).

The guidelines provided by Hayes (2009) regarding bootstrapping are adopted in this study. The analysis is conducted with 5000 bootstrap samples to assess the indirect effects. The control variables considered for bootstrapping are firm size, relationship duration, type of the firm and the remaining independent variables. The bias corrected 95% confidence intervals are estimated for the significant statistical indirect effects. To test hypotheses, the point estimates of the indirect effects are only significant in the case where zero is not contained in the confidence intervals. Following sections discuss the testing of the multiple mediation hypotheses proposed in Chapter 3.



### 5.5.2 Supplier capability and information sharing

Hypotheses 1a, 4a and 7a state that the contractual and relational governance mediate the relationship between supplier capability (R&D: Hypothesis 1a, production: Hypothesis 4a, and support: Hypothesis 7a), and information sharing in buyer-supplier collaboration. This asserts that supplier capabilities are related to information sharing through the intervening variables: contractual and relational governance. However, hypotheses 1b, 4b and 7b state that the relational governance will be more effective in mediating the capability and information sharing relationship. The regression results for the hypotheses 1, 4 and 7 are presented in table 5.5 and 5.6. In model 1 in table 5.5, Contractual governance is regressed on R&D, production and support capability, whereas in model 2, Information sharing is regressed on R&D, production, support and contractual governance in step 2 and 3. Similarly, Table 5.6 presents two regression models for relational governance and information sharing. In this section, the indirect effects of supplier capabilities on information sharing are also bootstrapped using the multiple mediation macro described in Preacher and Hayes (2008a). In case of causal steps method, the interpretation of the output is based on the significance of 'a' and 'b' paths. However, in bootstrapping analysis the emphasis is on the direction and size of the indirect effects. The detailed output of the 'indirect' macro for the dependent variable 'information sharing' and independent variables R&D, production, and support services capabilities are presented in table 5.7. The bootstrap analysis is superior than the causal steps method (Preacher and Hayes 2008a) and therefore, the results of bootstrap analysis is considered in this research to test the multiple mediation effect of contractual and relational governance on the relationship between supplier capability and Buyer-supplier collaboration.

#### *R&D capability and Information sharing*

In bootstrap analysis for the independent variable - R&D capability, the effects of production and support capabilities are controlled. Table 5.7 shows that in case of R&D capability, the specific indirect effects through contractual and relational governance on information sharing are significant with the point estimate ( $a*b$ ) of - 0.0310 and 0.0592 respectively. The total indirect effect through contractual and

relational governance is significant with the point estimate of 0.0282 and the 95% CI of 0.0404 to 0.1227. As a result, based on the principles of product-of-coefficient strategy, R&D capability has significant indirect effect on information sharing through contractual and relational governance. In relation to the link between R&D capability and information sharing, contractual and relational governance both have a mediating effect indicating support for Hypothesis 1a.

Examining the pairwise contrast of mediating variables is important to understand the significant difference between the indirect effects of the mediating variables. The pairwise contrast of the indirect effects through contractual and relational is conducted and It is found that zero is not contained in the BC 95% CI {-0.1921, -0.0184} for contrast. Therefore two indirect effects can be distinguished in terms of the magnitude. The specific indirect effect through relational governance is larger than the contractual governance. Therefore, relational governance has stronger mediating effect on the relationship between R&D capability and information sharing. This supports the arguments proposed in hypothesis 1b.

#### *Production capability and Information sharing*

Hypothesis 4 asserts that contractual and relational governance mediate the relationship between supplier production capability and information sharing (4a), and the individual effect of relational governance is stronger than contractual (4b). Table 5.7 shows the results for these hypotheses. The total indirect effect of production capability through both contractual and relational governance is significant with the point estimate of 0.1132 and CI of 0.0063 to 0.2490. The BC 95% CI for the specific indirect effect through contractual is -0.0285 to 0.0957. As zero is contained in this interval, the specific indirect effect through contractual is not significant. However, the specific indirect effect through relational governance is significant with the point estimate of 0.0989 and CI of 0.0147 to 0.2079. These bootstrap findings satisfy the criteria for the multiple mediation effects and therefore, production capability has a significant indirect effect on information sharing through contractual and relational governance. However, contractual governance doesn't contribute to this indirect effect. This provides support for Hypothesis 4a.

Further the analysis of pairwise contrast of the indirect effects through contractual and relational governance is conducted. The confidence interval (CI) value of contrast is found to be in the range of -0.1842 and -0.0009, which ensures that the magnitude of the indirect effects is significantly distinguishable. In this particular case, the indirect effect through relational governance is larger than contractual. Therefore, relational governance is more influential in the indirect effect of production capability on information sharing. This indicates full support for Hypothesis 4b.

#### *Support services capability and Information sharing*

Hypothesis 7 asserts that contractual and relational governance mediate the relationship between supplier support capability and information sharing (7a), and the individual effect of relational governance is stronger than contractual (7b). Results related to Hypothesis 7 are presented in table 5.7.

The total indirect effect of support capability on information sharing through both contractual and relational governance is significant with point estimate of 0.0525 and CI of 0.0894 to 0.1429. The specific indirect effect through contractual is also significant since the CI {0.0030, 0.1251} doesn't contain zero. The point estimate of the indirect effect through contractual is 0.0461. The specific indirect effect through relational is not significant with point estimate of 0.0064 and BC 95%CI of -0.1127 to 0.0938. Based on the indirect effect criteria of product of coefficients, the support capability has a significant indirect effect on information sharing jointly through contractual and relational governance. In this case, relational governance has no significant contribution to the total indirect effect. Bootstrap findings provide evidence in support of hypothesis 7a that states that the contractual and relational governance mediate the relationship between supplier support capability and information sharing.

Further the magnitude of the indirect effects through contractual and relational governance is examined by pairwise contrast of the indirect effects. It is found that zero is contained in the confidence interval {-0.0728, 0.1673} for contrast and therefore the two indirect effects cannot be distinguished in terms of the magnitude,

despite the fact that one is significantly different from zero and other is not. Preacher and Hayes (2008a) note that such apparent paradoxes can occur when one of the specific indirect effects involved in the contrast is not sufficiently far from zero. They argue that such paradoxes result from conducting multiple statistical tests that differ in power. Therefore, no evidence is found to support Hypothesis 7b.

**Table 5.5:** Regression results for mediating effect of contractual governance on capability – information sharing relationship

	Model 1 – Contractual Governance				Model 2 – Information Sharing					
	Step 1		Step 2		Step 1		Step 2		Step 3	
	B	<i>t</i>	B	<i>t</i>	B	<i>t</i>	B	<i>t</i>	B	<i>t</i>
Firm size	-.05	-2.01*	-.04	-1.98*	-.03	-.33	-.02	-.25	-.01	-.12
Duration of relationship	-.02	-.22	-.02	-.21	.06	.75	.05	.65	.04	.39
Manufacturer	.03	.42	.01	.11	.05	.62	.02	.28	.02	.26
Service provider	-.10	-1.42	-.09	-1.12	-.04	-.44	-.04	-.41	-.01	-.14
R&D capability			-.18	-2.57*			.14	2.03*	.09	1.30
Production capability			.10	1.12			.17	2.35*	.12	1.50
Support capability			.27	3.37**			.15	2.14*	.11	1.47
Contractual governance									.19	2.38*
$\Delta R^2$		.07		.15**		.05		.10*		.02*
Overall $R^2$		.07		.22		.05		.15		.17
Adjusted $R^2$		.03		.18		.02		.11		.13

\* $p < .05$ , \*\* $p < .01$

**Table 5.6:** Regression results for mediating effect of relational governance on capability – information sharing relationship

	Model 1 – Relational Governance				Model 2 – Information Sharing					
	Step 1		Step 2		Step 1		Step 2		Step 3	
	B	t	B	t	B	t	B	t	B	t
Firm size	-.03	-.37	-.02	-.23	-.03	-.33	-.02	-.25	-.01	-.12
Duration of relationship	.04	.46	.01	.13	.06	.75	.05	.65	.02	.25
Manufacturer	.02	.22	.04	.48	.05	.62	.02	.28	.01	.11
Service provider	-.05	-.59	-.04	-.50	-.04	-.44	-.04	-.41	-.02	-.26
R&D capability			.12	2.02*			.14	2.03*	.09	1.28
Production capability			.18	2.82**			.17	2.35*	.13	1.61
Support capability			.05	.62			.15	2.14*	.11	1.37
Relational governance									.55	6.01**
$\Delta R^2$		.04		.14*		.05		.10*		.11**
Overall $R^2$		.04		.18		.05		.15		.26
Adjusted $R^2$		.01		.14		.02		.11		.21

\* $p < .05$ , \*\* $p < .01$

**Table 5.7:** Summary of the bootstrapping results for multiple mediation effect on capability - information sharing relationship (5000 bootstrap samples)

	Independent variable (IV)	Mediating variable (M)	Specific indirect effect (a*b)	Bootstrapping (BC 95% CI)	
				Lower	Upper
1.	R&D capability	Contractual	-.0310*	-.0891	-.0003
		Relational	.0592*	.0042	.1517
		Total indirect effect	.0282*	.0404	.1227
2.	Production capability	Contractual	.0143	-.0285	.0957
		Relational	.0989*	.0147	.2079
		Total indirect effect	.1132*	.0063	.2490
3.	Support capability	Contractual	.0461*	.0030	.1251
		Relational	.0064	-.1127	.0938
		Total indirect effect	.0525*	.0894	.1429

(\*Significant point estimate,  $p < 0.05$ ) (BC – Bias corrected, CI – confidence interval)

### 5.5.3 Supplier capability and collaborative product/service development

In this section, hypotheses related to the multiple mediation effect of contractual and relational governance on the relationship between supplier capability and collaborative product/service development (CPD) are investigated.

Hypotheses 2a, 5a and 8a state that the contractual and relational governance mediate the relationship between supplier capability (R&D: Hypothesis 2a, production: Hypothesis 5a, and support: Hypothesis 8a), and collaborative product/service development in buyer-supplier collaboration. This asserts that supplier capabilities are related to the collaborative product/service development through the intervening variables contractual and relational governance. However, hypotheses 2b, 5b and 8b state that the relational governance will be more effective in mediating the capability and CPD relationship. The regression results for the hypotheses 2, 5 and 8 are presented in table 5.8 and 5.9. In model 1 in table 5.8, Contractual governance is regressed on R&D, production and support capability, whereas in model 2, CPD is regressed on R&D, production, support and contractual governance in step 2 and 3. Similarly, Table 5.9 presents two regression models for relational governance and CPD. The result of bootstrap analysis is considered in this research to test the multiple mediation effect of contractual and relational governance on the relationship between supplier capability and CPD. The summary result of the bootstrapping analysis for the dependent variable CPD and independent variables R&D, production, and support services capabilities are presented in table 5.10.

#### *R&D capability and Collaborative product/service development*

Table 5.10 shows that in case of R&D capability, the specific indirect effects through contractual and relational governance on CPD are significant with the point estimate ( $a*b$ ) of -0.0310 and 0.0635 and CI of  $\{-0.0739, -0.0021\}$  and  $\{0.0022, 0.1490\}$  respectively. The total indirect effect through contractual and relational governance is also significant with the point estimate of 0.0325 and the 95% CI of 0.0295 to 0.1279. As a result, based on the principles of product-of-coefficient strategy, R&D capability is found to have significant indirect effect on



CPD through contractual and relational governance. In relation to the link between R&D capability and CPD, contractual and relational governance both have the mediating effect. This provides support for hypothesis 2a.

The pair-wise contrast of indirect effects through contractual and relational is conducted and it is found that zero is not contained in the BC 95% CI  $\{-0.1801, -0.0142\}$  for contrast. Therefore two indirect effects can be distinguished in terms of the magnitude. The specific indirect effect through relational is larger than the contractual governance. Therefore, the relational governance has more specific contribution in the total indirect effect. This fully supports the hypothesis 2b.

#### *Production capability and Collaborative product/service development*

According to table 5.10, the total indirect effect of production capability through both contractual and relational governance is significant with the point estimate of 0.1006 and CI of 0.0034 to 0.2389. The BC 95% CI for the specific indirect effect through contractual is -0.0244 to 0.0940. As zero is contained in this interval, the specific indirect effect through contractual is not significant. However, the specific indirect effect through relational governance is significant with the point estimate of 0.0875 and CI of 0.0132 to 0.1907. These bootstrap findings satisfy the criteria for multiple mediation effects and therefore, production capability has a significant indirect effect on CPD through contractual and relational governance. This supports the arguments proposed in hypothesis 5a.

Moreover, based on the pairwise contrast of the indirect effects through contractual and relational governance, the confidence interval (CI) value of contrast is found to be in the range of -0.1759 and -0.0027. As zero is not the part of confidence interval, the magnitude of indirect effects is significantly distinguishable. In this particular case, the indirect effect through relational governance is larger than contractual. However, the specific indirect effect of contractual governance is not found to be significant. Therefore, relational governance is more influential in administering the indirect effect of production capability on CPD. This fully supports the argument proposed in hypothesis 5b.

*Support services capability and Collaborative product/service development*

Table 5.10 shows that the total indirect effect of support capability on CPD through contractual and relational governance is not significant since its confidence interval  $\{-0.0925, 0.1299\}$  contains zero. Similarly, the specific indirect effects through contractual is also not significant. However, the specific indirect effect through relational governance is significant with the point estimate of 0.0061 and CI of 0.0891 to 0.1151. Based on the indirect effect criteria of product of coefficients, the support capability has no significant indirect effect on CPD jointly through contractual and relational governance. Although, the relational governance is only specific mediator of the support capability and CPD relationship, the magnitude is so small that it is not able to make any significant contribution to total indirect effect. Hence in this case, bootstrap findings provide no evidence to support Hypothesis 8a, which states that, the contractual and relational governance mediate the relationship between supplier support capability and CPD.

Further the magnitude of the indirect effects through contractual and relational governance is examined by the pairwise contrast of the indirect effects. It is found that zero is contained in the confidence interval  $\{-0.0752, 0.1627\}$  for contrast testing, indicating that the magnitude of these indirect effects could not be distinguished. Therefore, no support has been found for Hypothesis 8b.

**Table 5.8:** Regression results for mediating effect of contractual governance on capability – CPD relationship

	Model 1 – Contractual Governance				Model 2 – Collaborative Product Development					
	Step 1		Step 2		Step 1		Step 2		Step 3	
	B	t	B	t	B	t	B	t	B	t
Firm size	-.05	-2.01*	-.04	-1.98*	-.06	-.75	-.04	-.52	-.02	-.24
Duration of relationship	-.02	-.22	-.02	-.21	.07	.88	.08	.92	.09	1.07
Manufacturer	.03	.42	.01	.11	.09	1.05	.05	.62	.03	.45
Service provider	-.10	-1.42	-.09	-1.12	-.07	-.79	-.06	-.71	-.03	-.46
R&D capability			-.18	-2.57*			.17	2.12*	.14	1.81
Production capability			.10	1.12			.16	2.05*	.11	1.37
Support capability			.27	3.37**			.19	2.37*	.15	1.91*
Contractual governance									.17	2.10*
$\Delta R^2$		.07		.15**		.05		.11*		.03*
Overall $R^2$		.07		.22		.05		.16		.18
Adjusted $R^2$		.03		.18		.02		.12		.14

\* $p < .05$ , \*\* $p < .01$

**Table 5.9:** Regression results for mediating effect of relational governance on capability – CPD relationship

	<b>Model 1 – Relational Governance</b>				<b>Model 2 – Collaborative Product Development</b>					
	Step 1		Step 2		Step 1		Step 2		Step 3	
	B	t	B	t	B	t	B	t	$\beta$	t
Firm size	-.03	-.37	-.02	-.23	-.06	-.75	-.04	-.52	-.01	-.15
Duration of relationship	.04	.46	.01	.13	.07	.88	.08	.92	.02	.21
Manufacturer	.02	.22	.04	.48	.09	1.05	.05	.62	.02	-.23
Service provider	-.05	-.59	-.04	-.50	-.07	-.79	-.06	-.71	-.01	-.17
R&D capability			.12	2.02*			.17	2.12*	.13	1.76
Production capability			.18	2.82**			.16	2.05*	.11	1.35
Support capability			.05	.62			.19	2.37*	.12	1.48
Relational governance									.50	5.53**
$\Delta R^2$		.04		.14*		.05		.11*		.09**
Overall $R^2$		.04		.18		.05		.16		.23
Adjusted $R^2$		.01		.14		.02		.12		.18

\* $p < .05$ , \*\* $p < .01$

**Table 5.10:** Summary of the bootstrapping results for multiple mediation effect on capability - CPD relationship (5000 bootstrap sample)

	Independent variable (IV)	Mediating variable (M)	Specific indirect effect (a*b)	Bootstrapping (BC 95% CI)	
				Lower	Upper
1.	R&D capability	Contractual	-.0310*	-.0739	-.0021
		Relational	.0635*	.0022	.1490
		Total indirect effect	.0325*	.0295	.1279
2.	Production capability	Contractual	.0131	-.0244	.0940
		Relational	.0875*	.0132	.1907
		Total indirect effect	.1006*	.0034	.2389
3.	Support capability	Contractual	.0419	-.0055	.1186
		Relational	.0061*	.0891	.1151
		Total indirect effect	.0470	-.0925	.1299

(\*significant point estimate,  $p < 0.05$ ) (BC – Bias corrected, CI – confidence interval)

#### **5.5.4 Supplier capability and collaborative problem solving**

In this section, hypotheses related to the multiple mediation effect of contractual and relational governance on the relationship between supplier capability and collaborative problem solving (CPS) is investigated.

Hypotheses 3a, 6a and 9a state that the contractual and relational governance mediate the relationship between supplier capability (R&D: Hypothesis 3a, production: Hypothesis 6a, and support: Hypothesis 9a), and collaborative problem solving (CPS) in buyer-supplier collaboration. This asserts that supplier capabilities are related to CPS through the intervening variables contractual and relational governance. However, hypotheses 3b, 6b and 9b state that the relational governance will be more effective in mediating the capability and collaborative problem solving relationship. The regression results for the hypotheses 3, 6 and 9 are presented in table 5.11 and 5.12. In model 1 in table 5.11, Contractual governance is regressed on R&D, production and support capability, whereas in model 2, CPS is regressed on R&D, production, support and contractual governance in step 2 and 3. Similarly, Table 5.12 presents two regression models for relational governance and CPS. The result of bootstrap analysis is considered in this research to test the multiple mediation effect of contractual and relational governance on the relationship between supplier capability and CPS. The summary result of the bootstrapping analysis for the dependent variable CPS and independent variables R&D, production, and support services capabilities are presented in table 5.13.

##### *R&D capability and Collaborative problem solving*

In case of R&D capability, the specific indirect effects through contractual and relational governance on CPS are significant with the point estimate ( $a*b$ ) of -0.0582 and 0.0609 and CIs of  $\{-0.0578, -0.0107\}$  and  $\{0.0053, 0.1383\}$  respectively, since zero is not contained in CI. The magnitude of total indirect effect through contractual and relational is small ( $a*b = 0.0027$ ), but significant with CI of 0.0157 to 0.1328. As a result, based on the principles of product-of-coefficient strategy, R&D capability is found to have significant indirect effect on

CPS through contractual and relational governance. Hence, it could be interpreted that contractual and relational governance both has the mediating effects on the relation between R&D capability and CPS. This supports the arguments proposed in hypothesis 3a.

The pair-wise contrast of indirect effects through contractual and relational is conducted and the results indicate that zero is not contained in the BC 95% CI {-0.1532, -0.0074} for contrast testing. Hence, two indirect effects can be distinguished in terms of the magnitude. It is found that the magnitude of the specific indirect effect through relational is slightly larger than the contractual governance. It means that the specific mediation effect of relational governance has more contribution in the multiple mediation effect. Therefore, the bootstrap estimates fully support the hypothesis 3b.

#### *Production capability and Collaborative problem solving*

According to Table 5.13, the total indirect effect of production capability through both contractual and relational governance is significant with the point estimate of 0.1036 and CI of 0.0040 to 0.2347. The BC 95% CI for the specific indirect effect through contractual is -0.0125 to 0.0732. As zero is contained in this interval, the specific indirect effect through contractual is not significant. However, the specific indirect effect through relational governance is significant with the point estimate of 0.0890 and CI of 0.0110 to 0.2093. These bootstrap findings satisfy the criteria of product of coefficient strategy and therefore, production capability has a significant indirect effect on CPS jointly through contractual and relational governance. This provides evidence to support hypothesis 6a.

Moreover, based on the pairwise contrast testing of the indirect effects through contractual and relational governance, the confidence interval (CI) value of contrast is found to be in the range of -0.2017 and -0.0069. As zero is not the part of confidence interval, the magnitude of indirect effects is significantly distinguishable. In this particular case, the indirect effect through relational governance is larger than contractual. The specific indirect effect of contractual governance is not found to be significant. Therefore, relational governance is

contributing more in the joint multiple mediation effect on the relation between production capability and CPS. This fully supports the argument proposed in Hypothesis 6b.

*Support services capability and Collaborative problem solving*

In bootstrap analysis for support capability, the effects of R&D and production capabilities are controlled. The total indirect effect of support capability on CPS through contractual and relational governance is significant since zero is not in its confidence interval {0.1022, 0.1158}. The point estimate of the total indirect effect is 0.0563. The specific indirect effect through contractual significant with point estimate of 0.0504 and CI of 0.0132 to 0.0809. However, the specific indirect effect through relational governance is not significant with the CI of -0.1007 to 0.0916. Based on the indirect effect criteria of product of coefficients, the support capability has significant indirect effect on CPS through contractual and relational governance. This fully supports the argument proposed in Hypothesis 9a.

Contractual governance is only specific mediator of the support capability and CPS relationship. Further the magnitude of the indirect effects through contractual and relational governance is examined by the pairwise contrast testing of indirect effects. Zero is not contained in the confidence interval {0.0821, 0.1209}, indicating that the magnitude of contractual governance is larger than for relational governance. Therefore, in this particular case contractual governance is more influential in mediating the indirect effect of support capability on CPS. Hence in this case, bootstrap findings provide no evidence to support Hypothesis 9b.



**Table 5.11:** Regression results for mediating effect of contractual governance on capability – CPS relationship

	Model 1 – Contractual Governance				Model 2 – Collaborative Problem Solving					
	Step 1		Step 2		Step 1		Step 2		Step 3	
	B	<i>t</i>	B	<i>t</i>	B	<i>t</i>	B	<i>t</i>	B	<i>t</i>
Firm size	-.05	-2.01*	-.04	-1.98*	-.03	-.31	-.03	-.33	-.01	-.14
Duration of relationship	-.02	-.22	-.02	-.21	.02	.23	.01	.13	.01	.11
Manufacturer	.03	.42	.01	.11	.04	.43	.06	.71	.06	.75
Service provider	-.10	-1.42	-.09	-1.12	.07	.87	.07	.85	.08	1.12
R&D capability			-.18	-2.57*			.15	1.87*	.08	1.03
Production capability			.10	1.12			.20	2.48*	.11	1.41
Support capability			.27	3.37**			.16	1.95*	.09	1.32
Contractual governance									.21	2.46*
$\Delta R^2$		.07		.15**		.04		.12*		.03*
Overall $R^2$		.07		.22		.04		.16		.19
Adjusted $R^2$		.03		.18		.01		.12		.15

\* $p < .05$ , \*\* $p < .01$

**Table 5.12:** Regression results for mediating effect of relational governance on capability – CPS relationship

	Model 1 – Relational Governance				Model 2 – Collaborative Problem Solving					
	Step 1		Step 2		Step 1		Step 2		Step 3	
	B	t	B	t	B	t	B	t	B	t
Firm size	-.03	-.37	-.02	-.23	-.03	-.31	-.03	-.33	-.04	-.41
Duration of relationship	.04	.46	.01	.13	.02	.23	.01	.13	.02	.21
Manufacturer	.02	.22	.04	.48	.04	.43	.06	.71	.03	.32
Service provider	-.05	-.59	-.04	-.50	.07	.87	.07	.85	.09	1.04
R&D capability			.12	2.02*			.15	1.87*	.10	1.25
Production capability			.18	2.82**			.20	2.48*	.13	1.62
Support capability			.05	.62			.16	1.95*	.19	2.37*
Relational governance									.46	5.12**
$\Delta R^2$		.04		.14*		.04		.12*		.05**
Overall $R^2$		.04		.18		.04		.16		.21
Adjusted $R^2$		.01		.14		.01		.12		.16

\* $p < .05$ , \*\* $p < .01$

**Table 5.13:** Summary of the bootstrapping results for multiple mediation effect on capability – CPS relationship (5000 bootstrap samples)

	Independent variable (IV)	Mediating variable (M)	Specific indirect effect (a*b)	Bootstrapping (BC 95% CI)	
				Lower	Upper
1.	R&D capability	Contractual	-.0582*	-.0578	-.0107
		Relational	.0609*	.0053	.1383
		Total indirect effect	.0027*	.0157	.1328
2.	Production capability	Contractual	.0146	-.0125	.0732
		Relational	.0890*	.0110	.2093
		Total indirect effect	.1036*	.0040	.2347
3.	Support capability	Contractual	.0504*	.0132	.0809
		Relational	.0059	-.1007	.0916
		Total indirect effect	.0563*	.1022	.1158

(\*significant point estimate,  $p < 0.05$ ) (BC – Bias corrected, CI – confidence interval)

## 5.6 Summary

The chapter has outlined the statistical analysis of the data collected for the purpose of this study. Initially the data are subjected to a number of preliminary analyses to examine the assumptions related to the statistical testing. The exploratory factor analysis is conducted to remove the less important items in the constructs of the theoretical framework. The Pearson correlation coefficient is used to find out the bivariate correlation between different variables. The validity and reliability of the measures are also examined in this chapter. The hypotheses discussed in chapter 3 are thoroughly investigated in this chapter. Bootstrapping based multiple mediation analysis is used to examine the multiple mediation effect of contractual and relational governance on the relationship between supplier capabilities and Collaboration types. The summary results of the hypotheses are presented in Table 5.14.

**Table 5.14:** Summary results of hypotheses

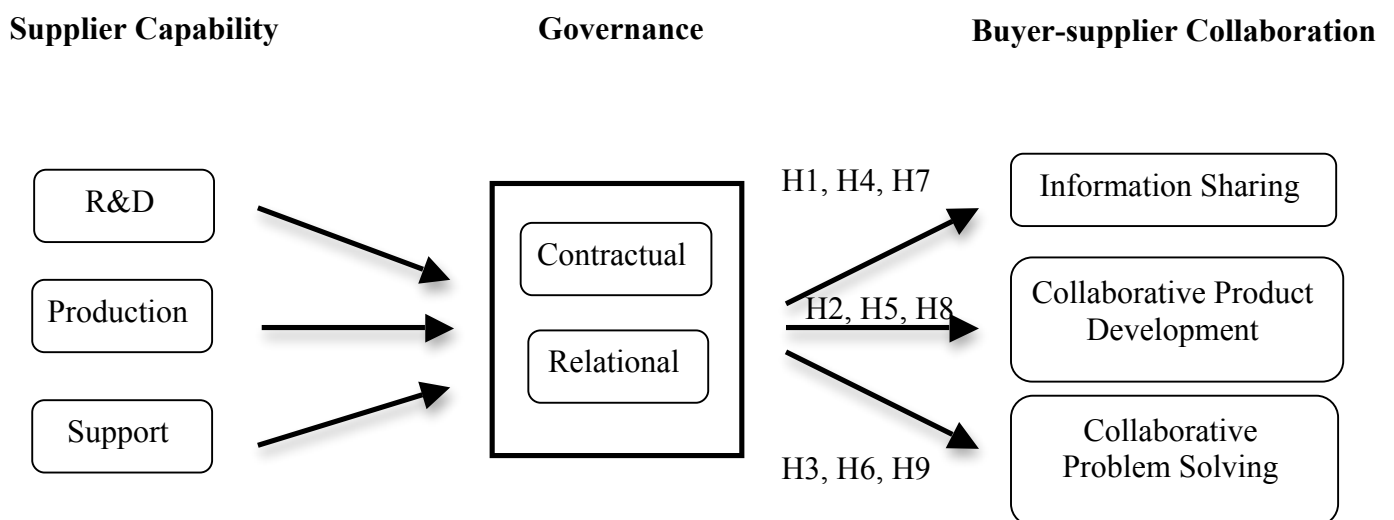
Hypotheses		Results
Hypothesis 1	a	Supported
	b	Supported
Hypothesis 2	a	Supported
	b	Supported
Hypothesis 3	a	Supported
	b	Supported
Hypothesis 4	a	Supported
	b	Supported
Hypothesis 5	a	Supported
	b	Supported
Hypothesis 6	a	Supported
	b	Supported
Hypothesis 7	a	Supported
	b	Not Supported
Hypothesis 8	a	Not Supported
	b	Not Supported
Hypothesis 9	a	Supported
	b	Not Supported

## CHAPTER 6

### DISCUSSION

#### 6.1 Introduction

Previous studies have concluded that supplier capabilities can influence the decision to engage in particular forms of buyer-supplier collaboration (Oh and Rhee 2008, Li et al. 2010). Similarly, it has been suggested that suppliers with specific inter-firm transaction governance can more effectively monitor these collaborative arrangements - and efficiently share resources, knowledge, etc. (Mayer and Salomon 2006, Hoetker and Mellewigt 2009, Liu et al. 2010). Given that theory suggests that the decision to adopt a particular form of governance structure depends on the balance between safeguarding firm capabilities and the intensity of collaborative engagement, this study sets out to establish the specific interactions between governance mix (i.e. contractual and relational governance), specific types of collaborative arrangement (information sharing - IS, collaborative product/service development – CPD and, collaborative problem solving - CPS) and capabilities possessed by the supplier (R&D, production and support). Developed hypotheses are based on the multiple mediation effect of contractual and relational governance on the relation between capability and collaboration type. The theoretical model developed earlier in this research is revisited in Figure 6.1.



**Figure 6.1:** Theoretical model

Discussion on findings of the study is structured in following sections: section 6.2 discusses the relationship between supplier R&D capability and Buyer-supplier collaboration (BSC). Section 6.3 discusses the relationship between production capability and BSC. Section 6.4 discusses the relationship between supplier support capability and BSC. Further, section 6.5 presents the effect of control variables such that firm size, relationship duration and type of the firm on the research findings. At the end, section 6.6 summarises the chapter.

## **6.2 R&D capability and Collaboration**

Hypotheses related to multiple mediation effect (indirect effect) of contractual and relational governance on the relationship between R&D capability and Buyer-supplier collaboration (BSC) type (IS - Hypothesis 1, CPD - Hypothesis 2, and CPS - hypothesis 3) are discussed in this section. Contractual and relational governance are hypothesised as the multiple mediators with relational governance have more influential effect on the relationship between R&D capability and BSC. In this study, R&D capability refers to the consistent spending on R&D related activities, consistent research output, ability to link the R&D activities with the market requirements and proven ability to develop new products and services. Contractual and relational governance focuses on administering the collaboration process with formal written agreements or informal relationships.

Information sharing is a common theme in the supply chain literature with more specific observations suggesting that inter-firm governance structure is the influencing factor in determining the degree of communication between buyer and supplier (Zirpoli and Caputo 2002). Support for hypothesis 1a (i.e. contractual and relational governance mediate the relationship between R&D capability and information sharing) is broadly consistent with this conclusion. This finding is also consistent with the previous studies of Poppo and Zenger (2002), Das and Teng (2000), Lee and Cavusgil (2006) and Liu et al. (2009). The process of aligning supplier R&D capability with market requirements necessitates access to relevant information from the buying organisation. Examining the specific indirect effects of contractual and relational governance, it is found that the relational governance effect is larger than that of contractual governance (hypothesis 1b). This provides supports for the argument that buyer-supplier relationship has more influential

effect in mediating the relationship between R&D capability and IS. This finding also seems to be consistent with the nature of the capability: given that R&D is largely embedded in the tacit knowledge of supplier's engineers and scientists, it is likely that the most effective information sharing would be through personal interactions at multiple levels of the organisation. This also echoes Dyer and Singh's (1998) argument that relationship based inter-firm collaboration tends to improve tacit information sharing. The preference of relational governance over contractual governance in presence of knowledge intensive R&D capability is consistent with the study of Hoetker and Mellewigt (2009) and Li et al. (2010).

Despite the slightly stronger emphasis on informal interactions in information sharing, it is important to note that the findings indicate the importance of both formal and informal interactions between buyer and supplier in the information sharing process. This inference is aligned with the argument proposed by Poppo and Zenger (2001), which conclude that contractual and relational both serve different purpose in the collaborative arrangement. Relational governance facilitates the process of collaboration across the organisation, it seems likely that contractual governance - with its emphasis on protecting intellectual property, scheduling regular meetings, mandating exchange protocols, etc. - provide the context for relationships to develop. To offer an analogy, it is not the commercial terms, confidentiality agreements, web format, etc of an on-line dating service that makes people fall in love, but if these things are inappropriate no relationships would emerge. Therefore, in the context of information sharing informal communication with the buyer is more important than holding each other on contractual terms specially when the communication is related to the R&D activities of the supplier. For an example in the aerospace industry, suppliers involved in developing and manufacturing a flexible robot system such as a snake arm robot have skills in specialised technology, which contribute towards its R&D capability. Designing and manufacturing a robot is a complex process and it involves a close interaction with customers (buyers) to understand the requirement and provide the customised solution in due time. Early stage information sharing related to the robot is important to understand the customer requirement due to high investment cost and customised nature of the product.

While in this study, contractual and relational governance are taken as independent variables, prior studies such as Poppo and Zenger (2002), Liu et al. (2009), Hoetker and Mellewigt (2009) and Li et al. (2010) have explored the relation between contractual and relational governance. Most of the studies seem to infer the relationship between contractual and relational governance as complementary. Findings of this study also support the argument that both forms of governance mechanism are needed for effective exchange of resources in BSC, and therefore partially support the complementarity of contractual and relational governance. The mix of contractual and relational governance is required for effective information sharing. When contracts codify each party's rights, duties, obligations, and responsibilities and specify goals (Reuer and Ariño, 2007), they create formal operating procedures that required for communication of knowledge. Thus, contracts may facilitate the development of buyer-supplier relation because contracts constitute an important platform for communication, a requisite byproduct is information exchange, especially codifiable information and routines that support the use of contracts (Li et al. 2010).

Similarly, empirical results in this research find support for the multiple mediation effect of the contractual and relational governance on the relationship between supplier R&D capability and CPD (hypothesis 2a). The specific indirect effects through contractual and relational governance are significant, indicating that both are separately influencing CPD activities (in the presence of R&D capability). As per information sharing, the pair wise comparison of both specific indirect effects show that the specific indirect effect through relational governance is larger than contractual (hypothesis 2b). . In other words, suppliers with greater R&D capability prefer more 'relational' inter-firm guiding mechanisms for CPD-related activities – including sharing skills to develop new products/services, working together at the early stage of project development, sharing the costs of new product/ service development, etc. That said, like information sharing, both mechanisms were central to effective management of the CPD activities. This finding is consistent with the study of Carson et al. (2006), which argue that formal and relational contracts each have advantages and disadvantages in specific situations and are not simply substitutes. They have considered the interorganizational relationships involving R&D for new-product development to support their arguments.



Technology intensive industry like aerospace heavily relies on the R&D capability of the supplier (Mayer 2006). For R&D in a relatively specialized product area, such as the aerospace industry, smaller suppliers as compared to the larger firms have limited market options and therefore have an incentive to leverage their R&D as widely as possible. Although suppliers with relevant R&D experience could better preserve the value of R&D investment, if the relationship with the buyer did not work out or if the buyer behaves opportunistically, many suppliers had limited options. Thus, the supplier firms had to engage in what might be described as a governance 'balancing act': motivated to share knowledge and more general know-how (enabled by relational governance), but also needing to avoid too much exposure to other parties (contractual governance giving a clearer delineation of the relevant property rights and a mechanism for enforcing those rights: Pisano 1990). The CPD process involves integration of know-how across different stages of the product development and knowledge exchange between buyer and supplier. Although relational governance would be appropriate to enhance the knowledge sharing process, it would be challenging to decide whether supplier transfers the information more than what is needed. Therefore, the mix of governance including the contractual aspect needs to be considered while deciding the boundary of the knowledge exchange.

This finding is also consistent with the study of (Olander et al. 2010), which indicates that both contractual and relational governance mechanisms play a role in buyer-supplier R&D collaboration but their relative importance varies according to the collaboration phase. However, both types of mechanisms should be considered simultaneously throughout the collaboration process. This sentiment is also evident in Oxley (1997), which argues that if the prescribed activities are not adequately monitored or enforced due to some gaps in specification, the possibility of moral hazard arises on either side of the transaction. For example, supplier with R&D capability may later find a better partner and so may deliver less or inferior knowledge to its partner than promised in the original agreement. On the other hand the recipient firm may use or modify the knowledge in ways that were not intended in the contract and which are injurious to the supplier. These types of problem are rooted in the need to transfer/share poorly defined tacit "know-how." However, tacit knowledge sharing is difficult without intimate personal contact and

participation. If buyer and supplier attempt to contract for the right to use an asset embodying significant tacit know-how, it would be challenging to adequately specifying the asset and associated property or usage rights to be transferred in a contract since the contracted assets do not exist at the time the contract is written and therefore the innovation process will become highly uncertain. Even designing a contract is more difficult to specify for a novel technology since the buyer and supplier share less of the tacit know – how associated with its application that is usual for more routine technology transfers. Repeated consultation with the buyer reduces the adverse effects of the resource sharing because of improved information developed over the course of previous consultations and relationship. In CPD related activities supplier and buyer may agree on certain level of aims and objectives in different stages of product development. Being flexible in making adjustments to cope with unexpected circumstances is important for smooth flow of the development process. Relational governance encourages the development of shared vision and goals between buyers and suppliers with a degree of confidence against opportunistic behaviour. Therefore, relational governance is more suited for the supplier with R&D capability to engage in CPD activities.

The finding partially supports the arguments proposed in Li et al. (2010) that formal contracts may complement the use of relational mechanisms in promoting knowledge acquisition. The presence of contractual governance can also strengthen the knowledge exchange between buyer and supplier. As reported by Li et al. (2010), more formalized contracts that specify the technologies underlying the task may also require information or the right to monitor the use of the technology. More complete and customized contracts often require reports with performance measurements (Barthélemy and Quélin 2006). The specification of performance metrics is a form of symbolic communication and further increases the level of explicit knowledge exchange between parties when they implement collaborative activities (Grant 1996). Contracts provide a template for coordinating the transfer of knowledge, which the firm can then apply in interactions with more distant suppliers, and it can provide formal specification and assurance, complementing the informal specification of shared goals and informal assurance of trust. In these ways, contracts reduce cognitive and coordination barriers and thus strengthen the impact of relational governance.

Collaborative problem solving (CPS) activities involve jointly working on problems related to cost, quality, design, delivery schedule and uncertain demand of the products. Here, the research findings support hypothesis 3a (i.e. contractual and relational governance mediate the relationship between R&D capability and CPS). The specific indirect effects of R&D capability through contractual and relational governance both are significant, which indicates that contractual and relational both have individual effect on the R&D – CPS relationship. It is also proposed that the relational governance will have stronger mediating effect in case of CPS. Interestingly, the contractual and relational governance are found to be equally influential (negligibly inclined towards relational governance) in mediating the R&D – CPS relationship (hypothesis 3b). Unlike Hypotheses 1b and 2b, the differential specific indirect effect through relational governance was only negligibly more influential than contractual governance. This could be understood in terms of the nature and duration of the activities involved in CPS. Complex problems related with product quality, delivery schedule etc., which need more engagement with the buyers to understand the problem and effectively working on long term solutions, may need a greater level of relationship with buyer. However problems, which are not in need of much resource commitment and are more generic in nature, may not need efforts to build higher level of relationship. As with discussions of CPD above, it seems logical that suppliers with greater R&D capability would be more willing to develop innovative problem solutions jointly with buyer. The broader scope of joint problem solving could help explain the more balanced findings with respect to governance: particular form of governance depends on the knowledge and previous experience of the supplier in dealing with the specific problem. For example, suppliers with R&D capability may be good at developing products or services and longer term relationships will be important in understanding product/service problems but when faced with short term or one off problems suppliers needed to be careful in safeguarding their expertise with proper contractual agreements. At the same time, cooperation –when for a short period - demands a level of mutual understanding and relationship. Moreover, suppliers with R&D capability may be good at developing the products or services but getting engaged in market or quality related problems might not be their priority. Further, the supplier's competitive position also affects the decision whether to commercialize its R&D skills through a cooperative arrangement or by its own

through a contractual agreement. The findings related to R&D – CPS relationship could be better understood in the context of aerospace industry. Companies in technology intensive industry can encounter generic (short term) as well as more complex problems, which may need help from specialist on longer-term basis. Although, contractual and relational both form of governance is important, relational governance may have a slight edge in the collaboration process. Relational governance involves the strengthening of ties between the exchange partners (e.g., manufacturer- supplier) and therefore promotes effective CPS (Dyer 1996, Dyer and Nobeka 2000). Shared goals in joint problem solving can harmonize individual self-interests and cast a forward-thinking orientation onto the exchange relationship. As a result of this commitment to cooperate, parties share necessary and valuable information, in the form of both explicit and tacit knowledge (Inkpen and Tsang 2005).

In summary, this research emphasises the role of contractual and relational governance in linking the R&D capability with the collaboration type. Across all three types of collaboration, there was evidence to support the argument that both forms of governance are required in buyer-supplier exchange. However, relational governance has been found to be more influential in almost all the three types of buyer – supplier collaboration process, especially when supplier has the R&D capability. This is consistent with studies of Hoetker and Mellewigt (2009) and Li et al. (2010).

### **6.3 Production capability and collaboration**

This section discusses the findings for the hypotheses related to the multiple mediation effect (indirect effect) of contractual and relational governance on the relationship between production capability and BSC type (IS - Hypothesis 4, CPD - Hypothesis 5, and CPS - Hypothesis 6). First, contractual and relational governance are proposed to mediate the relationship between production capability and BSC types (hypothesis 4a). Second, relational governance is hypothesised to have more influential in mediating the production capability – BSC relationship (hypothesis 4b).

Production capability refers to supplier proven ability to provide the products according to the customer (buyer) specifications at desired time, low cost and with

desired quality. Research findings suggest that the production capability has an indirect effect on information sharing jointly through contractual and relational governance. In other words, both contractual and relational governance are jointly effective in sharing the product and market related information. However, on analysing the pair wise indirect effects of contractual and relational governance, it is found that specific indirect effect of relational governance is larger than contractual. Findings further support the arguments proposed by Li et al. (2010) and Poppo and Zenger (2001, 2002) that contractual and relational governance works together to support the exchange process in collaboration activities. The frequent consultation with buying organisation seems to be logical in understanding the product specifications and market related information. Although, formal contract might be the necessity to decide on the lot size and cost of the products being delivered, buyer-supplier relationship is important for long-term informal information sharing for mutual benefits. Moreover, in absence of improper informal communication between buyer and supplier, it would be difficult to understand the uncertain demand pattern, which can further affect the inventory level of the supplier and as a result may increase the product cost. In this scenario, buyers may be willing to share real time demand information with the supplier if they have the confidence that the information will not be misused and exploited. This confidence can only be built through long-term relationship. Informal interaction at multiple levels will assist in communicating the real –time demand forecasting data with the supplier. The intention of supplier to be flexible and not holding the buyer on contractual terms is important to maintain the uninterrupted flow of information for long-term business benefits. For instance, manufacturing most of the components/equipments/parts in aerospace industry involve huge investment and therefore feasibility of the project needs to be understood in advance before engaging in the manufacturing process. This process involves communicating with the buyer on informal basis and building the relationship to understand the ‘nitty-gritty’ of the project such as the delivery schedule, quality desired etc. In this context relationship comes first to the contractual agreement to generate business and sort out the liability involved in the project.

Similarly, support for hypothesis 5 (i.e. hypothesis 5a: contractual and relational governance mediate the relationship between supplier production capability and CPD, and hypothesis 5b: the effect of relational governance is stronger) is found in the empirical research. The key activities involved in CPD process are to share the skills and knowledge in jointly developing the products. On analysing the pair wise indirect effects of contractual and relational governance, it is observed that the relational governance is more influential in administering the total indirect effect of production capability on CPD. The finding is consistent with previous studies (Dyer and Singh 1998) that conclude that relational governance is important to create value from joint capabilities and develop the sources of competitive advantage. It seems logical that knowledge exchange process is more effective when it is governed by informal relationship between buyer and supplier. Firms having greater level of confidence over the intent of other party will promote greater level of knowledge exchange in long run for mutual benefits. This is also echoed in the philosophy of 'guest engineer', where buyer and supplier work together at early stage of product development to achieve the desired quality of the product. In absence of good relationship between buyer and supplier it may not be possible to send engineers at their site to help in improving the production process. Moreover, relational experience perhaps enables them to specify contingencies more effectively by providing informal means to resolve disputes (Santoro and McGill 2005).

Although contractual governance can mitigate the risk of exploitation by buying organisation, previous studies (McEvily and Marcus 2005, Dyer and Hatch 2006, Nielsen 2010) argue that the extent of involvement in multiple activities in CPD would raise the difficulty to effectively specify the contractual terms. Increase in the number of products or technologies included in a contract, or increase in the geographic scope of the transaction, will inevitably increase the difficulty and cost of monitoring activities. This further indicates that relational governance would be more appropriate for CPD in presence of production capability. Suppliers with production capabilities may need to involve in a mixture of process design and production activities with the customer (buyer). These different "transaction types," which include design activities are most likely to involve the creation or significant modification of technology, so raising the difficulty of adequate specification of

contractual terms. Increase in the number of products or technologies included in a contract, or increases in the geographic scope of the transaction, will inevitably increase the difficulty and cost of monitoring activities. Building on transaction cost economy (TCE), if a contract is used to govern a project involving multiple firms such that buyer and supplier, monitoring costs will increase with the number of partners involved, as assigning accountability for pay-off relevant actions taken by multiple partners under uncertainty is problematic. In terms of relational governance, suppliers can better evaluate the buying firm's skills, judge its readiness in to perform the product development tasks, assess its ability to work on the project, and make adjustments when necessary. Therefore, building a relationship with the buying organisation to explore the opportunities to combine the resources/skills better equips the firm for CPD. Thus suppliers need to promote the informal interaction with the buying firm for CPD (in presence of production capability). For instance, suppliers dealing with production of mould tools and technical injection moulding for aerospace industry can engage in close relationship with buyer which can help in selection of the correct material, tooling and processes to produce the cost effective moulding solutions. Even developing or acquiring the relevant technology with the help of buyer to reduce the manufacturing cost is essential to cope with the current environment of faster cycles in technology change. Delivering the customised solution in a timely fashion needs to understand the buyer demand effectively and therefore, considerable investment in relationship development is necessary. Relational governance mechanisms effectively manage alliances rich in knowledge assets, but cannot be deployed simply at will. Rather, they depend on the existence of trust and social identification, which develop only as firms interact over time (Macaulay 1963, Uzzi 1997, Kale et al. 2000). Contractual governance mechanisms, in contrast, rely much less on prior interactions. Thus, early alliances between two firms should involve primarily physical assets, amenable to governance via contractual mechanisms, rather than knowledge assets, which the partners are ill-equipped to govern. These early alliances allow the firms to develop trust and social identification, making relational governance mechanisms more feasible. Later alliances can build on this to incorporate increasing amounts of knowledge assets.

Findings related to the indirect effect of production capability on CPS supports the hypothesis 6 (i.e. hypothesis 6a: contractual and relational governance mediate the relationship between supplier production capability and CPS, and hypothesis 6b: the effect of relational governance is more influential. Findings suggest that both contractual and relational governance have multiple mediation effect on production – CPS relationship. This finding is consistent with the study of Caniels et al. (2012), which clearly illustrates that relational governance is only beneficial for project outcomes when it is accompanied by contractual control. At the initial stage of collaboration, the governance mechanism that creates positive beliefs can foster the development of trust between collaborative partners (Inkpen and Currall 2004). As organisations start learning about each other, they rely more on the inter-firm relations than merely on the contracts. Interestingly, similar to hypotheses 4b and 5b, on analysing the pair-wise indirect effects of contractual and relational governance, it is found that relational governance is more influential in administering the total indirect effects. It seems logical that relation between buyer and supplier is important to share the informal information in anticipation of the problem related to product and market, and then working together to minimising the impact of the problem on the organisations (in presence of production capability). In absence of informal interaction between buyer and supplier it may not be feasible to take the advice of the supplier whenever needed. In CPS, the focus is on solving problems in the present without examining the appropriateness of current and future learning behaviours. Both organizations introduce only selected company-specific (or project-specific) knowledge to the relationship and the main outcome is transfer of complementary, mainly explicit knowledge suitable for that particular problem (Nielsen 2010).

Supplier with a greater production capability can be helpful in understanding the problems related to product quality and cost, and supplier expertise in production process may help to minimise the cost and improve the quality. Suppliers will be more willing to help the buyer in uncertain market condition if the inter-firm collaboration is based relationship rather than holding each other on the contractual terms. For example, if there is an urgent request for goods by the buyer in case they run out of their stock, supplier with good relationship can help in either fulfilling the urgent order form their stock or improve their production output to cope with the urgent request. This inference is further echoed in the Just – in – time (JIT)



principle, which is inclined towards promoting good relationship between buyer and supplier. It is natural to expect that supplier's increased production capability will positively impact CPS in presence of inter-firm relationship. Co-specialised assets, mutual trust and common language for technical issues can be developed through long-term repetitive transaction and working closely with the supplier (Oh and Rhee 2008). For example, suppliers with superior production capability shift from build-to-print to design for manufacture (DfM) approach to take cost out at the early stage of the process. This could be done with the help of buyer by involving in relationship based exchange process. Even the informal relation beyond the project is important to continue seeking the future business. Moreover, as the lead time for designing and building some equipment like gas turbines etc, in the aerospace industry is very long i.e. years, the demand for the equipment is poorly managed. Better relations with buyers can help to manage the demand related problems since building relations is a people-based activity and cannot be controlled by contracts.

In summary, although there is a strong evidence for mediating effect of both contractual and relational governance in three types of collaboration, the relational governance seems to have more influential effect in guiding the relationship between production capability and types of collaboration. Continuing the stream of TCE research, findings are consistent with the study of Goo et al. (2009) which argue that trust based on inter-firm relationship is important in constraining opportunism under both (contractual and relational) forms of contracting and it facilitates information sharing, harmonious conflict resolution, and mutual dependence (Gregory 2011). Findings also support the argument that firms can benefit by purposefully combining formal and informal governance mechanisms. For example, a combination of contractual and social mechanisms is more effective for managing conflict (Dyer and Singh, 1998), and the simultaneous use of relational norms and customized contracts enhances exchange performance (Poppo and Zenger, 2002). Firms get advantages of specifying formal arrangements and using plural approaches (i.e., both contracts and relational mechanisms) to absorb greater knowledge beyond the firm boundary (Li et al. 2010).

#### **6.4 Support capability and collaboration**

This section discusses the findings for the hypotheses related to the multiple mediation effect (indirect effect) of contractual and relational governance on the relationship between support capability and BSC type (IS - Hypothesis 7, CPD - Hypothesis 8, and CPS - hypothesis 9). Contractual and relational governance are proposed to mediate the relationship between support capability and BSC types. It is also proposed that relational governance has more influential effect in mediating the support capability – BSC relationship.

The supplier support capability includes activities related to maintenance or providing technical support activities to the buyer. Contractual and relational governance focuses on the intent of the supplier to administer the collaboration process with formal written agreements or buyer-supplier relationships. Full support in favour of hypothesis 7a (i.e. Contractual and relational governance mediate the relationship between supplier support capability and Information sharing with the buyer) is evident in the research findings. The total indirect effect through both contractual and relational governance is significant. Further the specific indirect effect through contractual is only significant (Contrary to hypothesis 7b). In the broad sense of the nature of support capability, if buyer is willing to collaborate for long term then a certain level of informal interaction is needed to facilitate the frequent information sharing. Given that the nature of information sharing related to product or market, both contractual and relational governance can be jointly effective. However, the extent of informal interaction depends on the duration of collaboration and type of the support activity required by the buyer. Supplier support capability can be viewed in terms of generic or functional capability and innovative support capability. Some of the support activity such that regular maintenance may not need a long - term engagement with the buyer and cost of those services would be the market winner criteria. In this scenario, contractual governance will be more appropriate in information exchange. However, in case of complex problems innovative support skills are required to think about '*out-of-box*' solution. In this scenario, more interaction with the buyer is required to work together on the support activities.

In the case of small and medium-sized suppliers most of the support activities may include a limited engagement with buyer with a very limited level of resources commitment from the buyer. The contractual governance seems to be more appropriate in this limited interaction period to avoid any fear of opportunistic behaviour. Often buyers may be willing to hire the supplier with appropriate support capability when the need arises and therefore, in most of the cases, the supplier may not require real time information sharing. The required information can well be shared under the guidelines of the contractual agreement. The formal agreement may safeguard the buyer from sharing information at the desired level. Even monitoring the expected outcome can be more effective in presence of contractual agreement. Contractual governance provides the safeguards against the opportunistic behaviour in exploiting the information shared in the short-term interaction. Formal written contracts can provide a 'legal safety net' in lieu of over reliance on mutual trust and commitment (Goo et al. 2009). This finding is consistent with the study of Hoetker and Mellewigt (2009), which reports that relational governance could be a expensive approach to coordinate physical resources and contractual governance mechanism provide effective and efficient governance and coordination of these assets.

Contrary to initial expectation, hypothesis 8 (i.e. hypothesis 8a: Contractual and relational governance mediate the relationship between supplier support capability and CPD, and hypothesis 8b: the effect of relational governance is more influential) is not supported by the research findings. The total indirect effect through contractual and relational governance on the relation between support capability and CPD is not significant. However, the specific indirect effect through relational governance is significant. This result can be understood in the context of the nature of the support capability and the type of collaborative activities involved in CPD. The activities involved in jointly working on developing product and services may not be of much interest to the suppliers with support capabilities. Activities related to maintenance and providing IT support are not closely related to the knowledge sharing activities in the CPD process. If the need arises to get any information or advice from suppliers proficient at providing technical support, the buyer organisation can seek their help on an informal basis. However, this ad hoc assistance can only be feasible when buyer builds a strong relationship with the

supplier. The expertise of the supplier having support capability is more related to the activities at the later stage of the product life cycle. However the activities involved in new product development are more important at the early stages. It seems logical that there is a slight mismatch between the skills possessed by suppliers and the skills desired in CPD. In this scenario, the relational governance may be helpful in just informally exploring the potential contribution supplier could make, if any, in the CPD process. For functional support services capability, there may be a number of competitors available in the market and therefore suppliers involved in functional support services tend to involve in contractual agreement with the buyer in collaboration activities. However, suppliers with innovative support services capability tend to engage in long-term relationships in activities related to CPD. Suppliers with innovative support capability need to commit more resources in collaborative activities. Suppliers engaging in support activities in product development generally agree to do contract-based research and development and share the incentives with the buyer, and look for a win-win agreement. Suppliers in aerospace industry identify the importance of sharing the part of intellectual property (IP) that is regulated by contracts, and meet the managers of the buying firm frequently even if they don't have anything specific to discuss. Moreover, suppliers in aerospace industry understand that the relationship with manufacturers is essential in a globally uncertain business environment to ensure growth long-term. Strong relationships with manufacturers provide an optimal technical support during the process of concept development to the production, especially in the marketplace where short delivery lead-time and quality products are essential for the business.

Empirical findings fully support argument proposed in hypothesis 9a (i.e. contractual and relational governance mediate the relationship between supplier support capability and CPS). However no support has been found for hypothesis 9b (i.e. the effect of relational governance is more effective in mediating the support capability – CPS relationship). The multiple mediation effect through both contractual and relational governance is significant. However, the contractual governance has stronger indirect effect than relational. The finding is consistent with the study of Cai et al. (2009), which argues that legal contract serves as an important foundation of joint problem solving. The nature of support capability and

the type of activities involved in CPS seem to be congruent in the sense that most of the problem solving activities after the sale of the product would be effectively carried out by the supplier with better experience in providing support services. The short-term problems could be more contractual in nature in which buyer may not be willing to commit any resource sharing for the suppliers. The new trend of providing the product with the life - time support services is increasing in aerospace industry. Most of the suppliers in aerospace industry are selling their products with a long-term commitment of full time maintenance and support after sales. The increased competition in the market creates the instability of future business for suppliers dealing with support services. In this case more and more suppliers are inclined to engage in collaborative arrangements based on the contractual agreement. It is also convenient for buying organisation not to worry about the support services and choose the supplier based on better services at lower cost, since the problem solving activities demand a low level of interaction between supplier and buyer. Moreover, supplier with greater support capability will have more power to influence the contracting terms or negotiate on the service price. If the existing volume with the present buyer (customer) is large, supplier can make an effort to keep getting the business by providing some extra services or discount on services provided. On the other hand, support services in case of emergency situations like in-process breakdown can demand for premium price. In this case, contractual agreement is important to decide the roles and responsibilities of supplier and buyer, and the level of resource commitment both need to put in. With a greater support capability and contractual governance, suppliers not only diversify the risks but also strengthen the bargaining power. In CPS, the focus could be on short-term profit maximization, and therefore a carefully drafted license agreement in order to manage (control) the flow of proprietary knowledge is more appropriate (Nielsen 2010).

For instance, suppliers involved in providing specialised services in information and communication technology for Commercial-off-the- Shelf (COTS) products agree that every project or programme starts with a period of informal discussion and research which may last for up to a year before signing a formal agreement. Supplier with greater support capability extends the relationship to understand the scope and availability of the services tailored to the customers' individual

requirements and service level expectations. This pro-active support services help to drive down the cost of support through identifying and rectifying any problems encountered during implementation process. Even suppliers involved in providing technical support for concept design to comprehensive end-to-end testing for hardware and software product for aerospace company tends to incorporate an annual review process in-place to handle possible risk of intellectual loss during the collaboration process. For example, the concept of Power-by-the-hour (PbtH) has radically changed the business model in the aerospace industry. In the past, contracts didn't cover the spare components needed to maintain equipment such as the turbine through its working life, and the general approach adopted by the industry was '*the more spares the better!*' In current changed business scenario, suppliers involved in providing lifetime support tends to incorporate the terms and conditions in the contractual agreement and provide an on-site support staff to the customer (buyer). The degree of contractual completeness depends on firm's desire to minimize the costs associated with contractual exchange (Crocker and Reynolds 1993). The legal and economic consequences of violating a contract make it difficult for partners to take advantage of each other and thereby improve the stability of the collaboration (Lusch and Brown 1996). Contractual agreement will make it possible to negotiate the terms and conditions of the problem solving activities. In current presence of market uncertainty, stronger support capability may even help in crafting better ex ante contracts to clearly define the roles and responsibilities of each party, specify the resources to be exchanged, identify appropriate milestones, stipulate monitoring mechanisms and introduce appropriate pecuniary incentives. Increased uncertainty even reduces the level of relationship and supplier capability may become less relevant for the collaborative arrangement with buyer (Oh and Rhee 2008). Buying firms tend to less engage in collaborative problem solving with suppliers not stronger in the support capability and even tend to invest less in them when the market uncertainty is higher (Balakrishnan and Wernerfelt 1986, Bensaou and Anderson 1999). Buyers are less willing to share information with suppliers on informal basis, which have weaker capabilities to solve problems caused by higher technological uncertainty. Although, contractual governance will have an influential mediating effects between support capability and CPS relationship, a minimal level of relationship is required to get the business (contract) from the buyer. The nature of resources exchanged in the CPS could be

of physical nature such as providing spare parts for maintenance, and therefore contractual governance could be more suitable for mediating the relationship. The findings are consistent with prior studies, which argue that for physical assets, relational governance mechanisms will be more time-consuming and often costly than the contractual mechanisms (Hoetker and Mellewigt 2009). Furthermore, there is less need to—and less value in—developing coordinating routines, a common language or a sense of social cohesion when coordinating the use of physical assets. The transfer of physical assets makes it possible to transfer the fruits of productive knowledge between firms without requiring the receiving firm to master that knowledge (Demsetz 1988).

In summary, except in the case of CPD, both contractual and relational governance have mediating effect on the relation between support capability and collaboration type. However, contractual governance seems to have stronger effect on this mediation. The findings are consistent with the argument proposed by Das and Teng (1998), and Poppo and Zenger (2002), which argue that a mix of formal and relational mechanisms may be necessary to manage the exchange of resources in buyer-supplier collaboration.

## **6.5 Control variables**

In this study four types of control variables are identified and examined during empirical analysis process. These four variables are: firm size, relationship duration and two dummy variables for type of the firm (manufacturer and service provider).

Firm size is measured in terms of the number of employees in the firm. It is observed that the firm size is significantly and negatively related to the contractual governance. This indicates that bigger firms will tend to force contractual based inter-firm transaction with the customer (buyer) in the supply chain. The reason may be understood in the context of the power of the parties in the collaborative arrangement. Bigger firms may have more power to enforce the contractual based governance in collaborative arrangement. However, smaller firms tend to engage in collaborative arrangement with lower level of contractual agreement and prefer to

work out the deal. Previous research suggests that firm size affects the organizational behaviour (Scherer, 1980; Miles, 1980) in general and organizational boundary decisions in particular. However the effect of firm size is not very certain. Moreover, firm size also has positive effect on the R&D capability. This indicates that bigger firms tend to have greater level of R&D capability as compared to smaller firms. Larger firms may have more resources to invest in developing the internal capabilities. Theoretically, the effect of firm size on R&D capability is unclear (Pisano 1990). However, larger firms will have an advantage of economies of scale on buying the resources for equipment for research purposes. No any significant relation of firm size with other capabilities is found. This reinforces the fact that increasing firm size also adds up to the complexity of administrative processes and therefore can negatively impact the capability development process.

Duration of relationship is measured in terms of the time period since the supplier is working together with the buyer. It is observed in the findings that relationship duration has a positive and significant effect on the relational governance. This indicates that suppliers having longer relationship duration with the buying organisation tend to engage in relation-based governance for inter-firm transaction. Buyer and suppliers who have no mutual experience of working together, have no information that would discount the presumption of opportunism that is associated with asset specialization, while buyer and suppliers with this experience share an anchoring point for expectations about behaviour (Santoro and McGill 2005).

In terms of the relation with the type of the firm, manufacturing firms are found to have a positive and significant relation with the contractual governance. However, service providers are negatively related to the contractual governance. This finding can be understood in context of the type of the activities manufacturers and service providers involved in. In case of manufacturing related activities contractual governance may influence the buyer supplier transaction process. On the other hand, a greater level of interaction with buying organisation is needed for suppliers involve in providing services.



## 6.6 Summary

Chapter 6 focuses on interpreting the findings of the empirical study in context of the research questions and the hypotheses proposed in relation to this study. This research emphasises that the governance mechanism (contractual and relational) acts as a ‘bridge’ between the supplier capabilities (which is internal to the firm and inside the firm boundary) and buyer – supplier collaboration (which is external to the firm boundary). Engaging in collaborative arrangement with the buyer need to be built up through the formal agreement about the extent of the resource commitment and the personal informal interaction at multiple level of the firm. The Empirical findings related to the indirect effect of supplier capabilities on BSC types fully support the hypotheses 1, 2, 3, 4, 5 and 6. Support in favour of hypotheses 7a and 9a has been found. However, hypotheses 7b, 8a, 8b and 9b are rejected. In most of the cases, the argument that both contractual and relational governance mediate the relation between capability-collaboration is supported. The exception is found in the case of support capability – CPD relationship where the multiple mediation effect is not significant. However, the specific indirect effect of contractual and relational governance varies across the relationship between supplier capabilities and BSC types. The summary results of the specific indirect effects through contractual and relational governance are found in Table 6.1.

**Table 6.1:** Comparison of the specific indirect effect of contractual and relational governance (R - Relational governance, C - Contractual governance)

Supplier capability		Buyer – supplier collaboration type		
		Information sharing	CPD	CPS
	R&D	R>C	R>C	R>C
	Production	R>C	R>C	R>C
	Support services	-	-	C>R

In case of R&D and production capability, relational governance has stronger effect than the contractual governance. However, a mix result of preference over relational and contractual governance is found in case of support capability. Contractual governance seems to be more influential in mediating the support – IS and support – CPS relationship. Similar to prior work, the finding supports the argument that relational and contractual governance mechanisms often co-occur. Each has distinct limitations, making the optimal combination of governance mechanisms highly dependent on the nature of exchange resources and content of the particular collaboration activity.

## **CHAPTER 7**

### **CONCLUSION AND REFLECTION**

#### **7.1 Introduction**

The chapter aims to conclude the study by summarising the key objectives of research and, contribution made in theoretical and practical context. The study explores the relation between capability, governance and buyer-supplier collaboration type. The supplier perspective on buyer-supplier collaboration is considered in this study to examine the indirect effect of supplier capabilities (R&D, production and support) on different dimensions of BSC (information sharing, CPD and CPS) through contractual and relational governance.

The chapter is organised as follows: section 7.2 discusses the academic contribution of this study; the practical implication of the study is presented in section 7.3; potential limitations of this study is discussed in section 7.4; section 7.5 discusses the future research direction; and at the end, section 7.6 presents the concluding remarks related to this study.

#### **7.2 Academic contribution**

The study investigates the relationship between supplier capability, inter-firm governance mechanism and buyer-supplier collaboration (BSC). The buyer-supplier dyad is considered as the unit of analysis in this research. An integrative framework of capability, governance and collaboration has developed to understand the importance of capability-governance alignment in BSC. The framework is developed on the argument that the type of resources/capabilities (Physical or knowledge) involved in collaboration, affects the governance mechanism for the exchange process (Hoetker and Mellewigt 2009). Contractual and relational governance mechanisms differ in their ability to support the coordination of inter-firm activities in presence of different capabilities (Li et al. 2010). Although, previous studies discuss the importance of contractual and relational governance in effective exchange of resources in inter-firm collaboration, limited attempt has been made to include the supplier capability in this discussion (Oh and Rhee 2008). The primary contribution of this study is to empirically

examine the inter-relation between supplier capabilities, governance mechanisms and buyer-supplier collaboration types.

Studies related to understanding the impact of BSC on firm performance are abundant in literature, but the effect of firm capability on BSC has not gained much attention (Oh and Rhee 2008). Moreover, studies that discuss the existence of BSC do not provide a comprehensive view of heterogeneous types of collaboration (Giunipero et al. 2008). A generic approach to collaboration is used, which is not very informative in understanding the different types of activities involved in collaboration. A coherent classification of collaboration is required to understand the relationship between capabilities and BSC types (Crute et al. 2008). Understanding BSC in the perspective of the nature of the activities involved rather than in a generic sense can help to focus on the particular activities interest to suppliers. For the purpose of this study, BSC is categorised as collaborative information sharing, collaborative product development (CPD) and collaborative problem solving (CPS). These three categories of BSC are based on the purpose, nature, time scale and the type of resources involved in the exchange process. The collaboration types selected in this research are comprehensive to cover the most critical activities in BSC and provide a snapshot of the variety of activities involved in BSC. This research contributes in providing the supplier perspective of collaboration.

The holistic view of capabilities across the product lifecycle is considered while selecting the three functional capabilities of the supplier (R&D, production and support services capabilities) in this study. R&D capability is most important at the early stages of product design and development, production capability is important while working on transforming raw materials into the final product, and support capability may be more important in providing IT support, technical support etc. after the sale of the product (Chen and Chen 2003, Jacobides and Winter 2005). Unique nature of these capabilities and varying mix of physical and knowledge resources in the exchange process are influential in deciding the appropriate form of governance mechanism (Hoetker and Mellewigt 2009). This study provides support for the argument in literature that the type of resources/assets involved in the exchange process is important to choose a particular form of governance

mechanism in the inter-firm collaboration. Resources/assets shared in different types of collaboration such as IS, CPD and CPS are different and therefore, the governance mechanism to deal with those transactions may vary.

The empirical analysis of the relationship between supplier capability, governance and buyer-supplier collaboration highlights the importance of contractual and relational governance in collaborative activities. In examining the multiple mediation effect of contractual and relational governance on the relationship between capability and collaboration, the results show that both forms of governance mechanisms are important in exchange process. Both serves different purpose in collaboration exchange and cannot take the role of other (Liu et al. 2009). This research contributes in providing the empirical evidence in partial support of the assertion that both contractual and relational form of governance act as complementary rather than substitutes in BSC (Poppo and Zenger 2002, Li et al. 2010). Contracts without informal relationship and relationships without a formal agreement are not sustainable in managing physical and knowledge resource sharing in collaboration. If the roles and responsibilities of buyer and supplier are formalized *ex ante* through contracts, it can narrow the scope of *ex post* actions. Contracts can provide a formal framework to make collaborative decision and decide the boundary of the collaborative activities. However, relational governance promotes the parties to be proactive in value creation in BSC beyond what a contract has specified. Relational governance has its limit on safeguarding against opportunist behaviour (Lee and Cavusgil 2006). For instance, too much trust is as bad as too little trust, because one firm's high level of trust will lower its commitment to monitoring and may even make it easy to be exploited by a partner. Moreover, it is also less viable to constrain opportunism through social sanctions than contractual punishments. An individual party may loose its economic benefits as outlined in the contract if it plans to pursue only its private gains at the expense of collective gains in collaboration (Liu et al. 2009). On the other hand, contracts may lack flexibility especially in unforeseen circumstances and in this case relational governance will be helpful in being adaptive to changing environments due to their flexibility. Relational governance promotes open communication and, therefore dealing with unforeseen problems in future could be easier. Caniels et al. (2012) also clearly illustrate that relational governance is only beneficial for project

outcomes when it is accompanied by contractual control. This study supports the argument that formal (contractual) and informal (relational) governance mechanism mutually redress each other's deficiency and reinforce each other's function when they come into play together (Granovetter 1985, Liu et al. 2009, Li et al. 2010).

Although this research offers empirical insights into the complementarity view of governance, it also demonstrates that the degree of indirect effect of contractual and relational governance varies in presence of particular supplier capability (R&D, production or support services). Relational governance has stronger mediating effect in most of cases except the support capability – IS and support capability – CPS relationships. Contractual governance seems to be more influential in mediating the support – IS and support – CPS relationship. This research contributes in providing the empirical analysis for understanding the relative effectiveness of contractual and relational governance in the capability - collaboration relationship. Findings of this study support the arguments proposed in literature (Hoetker and Mellewigt 2009, Li et al. 2010) that the superiority of one governance mechanism over other in inter-firm exchange depends on the degree of physical assets (which are easy to codify and transmit across the firm boundary) and knowledge assets (which are based on intangible know-how and skills, and difficult to transfer) in the firm capability. The importance of relational governance in most of cases in this study also supports the arguments that the physical assets are more suited to contractual governance, whereas knowledge assets are best suited to relational governance in exchange process.

This study identifies the importance of alignment between inter-firm governance mechanisms, internal capability and the types of collaboration between supplier and buyer. This will help to understand why firms prefer to choose contractual or relational governance in presence of various sets of capabilities. Certain capability can demand more safeguards for spillover due to heavy commitment of resources it may need. The alignment of capability and governance should be such that it effectively safeguards the intellectual property rights (IPR) as well as promote efficient sharing of the resources to work together on collaborative projects (Zhou et al. 2008). This study helps to understand the rationale behind the alignment of capability with particular governance mechanism in order to achieve greater

performance in collaboration. This study helps in understanding the role of contractual and relational governance in the relationship between supplier's capability and type of collaboration.

This study combines the arguments of two-prominent theories in management research, Resource Based View (RBV) and Transaction Cost Economics (TCE) to provide a holistic view in explaining the inter-relation between capability, governance and buyer-supplier collaboration. RBV focuses on internal capability of the firm, while TCE provides useful insight in inter-firm transaction process. TCE fundamentally understands the characteristics of transactional exchange and while explaining, it typically holds firm capability constant. Therefore, TCE is not able to explain how differing firm capabilities influence governance. Moreover, although RBV provides insights into firm capabilities, which can generate value, little attention has been devoted to understand how capabilities impact governance. This study considers both RBV and TCE to understand the effect of supplier capability on types of BSC through contractual and relational governance. It argues that although the capability of the supplier is important for the competitive advantage, the decision on inter-firm governance mechanism in the perspective of the capability of the supplier is equally important to enjoy the benefits of collaboration. The arguments proposed in this study demonstrate the relevance of combining postulates of RBV and TCE to understand BSC. Combining RBV and TCE to explain the phenomenon of collaboration has been supported by the studies of McIvor (2009), Meyer et al. (2009), Gulbrandsen et al. (2009) and Argyres and Zenger (2012).

This study supports the argument that RBV complements TCE to understand the exchange process in inter-firm alliance (Meyer et al. (2009). TCE has long recognized a variety of sources of asset specificity, but most studies have not distinguished between them when predicting the appropriate governance response. As transaction cost research moves from studying industries dominated by physical assets, e.g., coal (Joskow 1987) and shoe manufacturing (Masten and Snyder 1993), to high-technology, knowledge-intensive settings, e.g., technology transfer alliances (Oxley 1999), it will become increasingly important to understand the impact of the resource type on the governance mechanism. The study supports the

arguments proposed by Argyres and Zenger (2012) that the RBV and TCE are in fact so intertwined dynamically that treating them as independent in explaining the exchanges beyond firm boundary is fundamentally misleading. The finding of this study provides support for the ongoing argument of extended-RBV (Lewis et al. 2010) and note that the importance of inter-firm relation cannot be overlooked while discussing the competitive advantage in Buyer-supplier collaboration.

This research also makes contribution in demonstrating the multiple mediation analysis technique in the operations management area. Despite the superiority of bootstrapping based multiple mediation analysis over casual steps approach and sobel test, it is under-utilised in the operations management area. Although, causal steps approach (Baron and Kenny 1986) is one of the most widely used method for testing hypotheses about intervening variables effects, it has often been criticized for detecting the intervening effects (Fritz and MacKinnon 2007, MacKinnon *et al.* 2002). The causal approach is not based on the quantification of the very thing it is attempting to test i.e. the intervening effect. Moreover, Sobel test assumptions are less likely to be satisfied for small to moderated sized samples (Preacher and Hayes 2008b). In contrast to the Sobel test, bootstrapping doesn't use the standard error to interpret the results and avoids the controversy behind estimating the standard errors of the indirect effect. Bootstrapping also doesn't assume normality for the sampling distribution and are known to be more powerful than the sobel test (Hayes 2009). In this study bootstrapping technique is used to test the hypothesised multiple mediation/indirect effects of contractual and relational governance on the relationship between capability and collaboration. The multiple mediation analysis technique used in this study is more robust than the most popular method of casual steps or sobel test and therefore, the findings of this study can be interpreted with more confidence.

### **7.3 Practical implications**

BSC is increasingly becoming critical in maintaining the competitive advantage in the market. This study can pave the way to understand a number of practical issues in managing the supply chain collaboration. While the benefits of collaboration have been widely discussed in business community, the understanding of how to effectively manage the collaborative arrangement is still developing.



This study provides key insight in linking the capability with the inter-firm governance mechanism in the context of different types of collaboration. It is found that the exchange between buyer and supplier depends on the type of resources involved in collaboration. Capabilities, which are deeply embedded in the personnel of suppliers, need a greater level of interaction at multiple levels with the buying firm for effective sharing. Findings of this study support that the information and knowledge are more effectively shared between buyer and supplier through relational governance. The level of trust and relationship between buyer and supplier are important factors in deciding the sharing process. Contractual governance is more effective whenever there is a need to impose safeguard measures to protect the intellectual property against opportunistic behaviour. This study helps in improving the practical understanding of using contractual and relational governance together in improving BSC performance. The study demonstrates that both contractual and relational governance are important in managing different types of BSC. Managers should understand the nature of both contractual and relational governance and appropriately manage the resources to engage in formal and informal interactions with the buyer/supplier. This study also provides empirical support for the relative importance of one governance mechanism over another in presence of particular supplier capability and collaboration type. Both buyer and supplier need to be committed in designing and exercising the optimal governance structure in BSC. This study is important for practitioners in terms of providing the relative importance of contractual and relational governance in the particular setting of capability-collaboration arrangement.

Another lesson learned from this study is that the alignment between capability and governance mechanism is critical to enjoy the benefits of buyer-supplier collaboration and to protect the skills/knowledge intact wherever necessary. In absence of proper understanding of the nature of capability and the effective inter-firm exchange process particularly suited for those capabilities, it would be challenging for managers to realise the potential benefits of collaboration. Results of this study help to understand the linkage between capability (R&D, production and support) and collaboration types (Information sharing, CPD and CPS) in exchange process. It may be possible that investment on relation specific resources

may not be beneficial if only the physical resources are involved in the exchange process (Hoetker and Mellewigt 2009). The allocation of resources to facilitate collaboration could be better managed with the knowledge of right alignment of capability and governance. Managers can make better decisions on the extent of formal and informal interactions with suppliers or buyers in light of the finding of this study. Both physical and knowledge based resources may contribute to the collaboration's goals (de Figueiredo and Teece 1996) and therefore, both forms of governance mechanism are important. However, when asset types are mixed, the partners will have to choose suboptimal governance arrangements. If the alliance can be narrowed to either predominantly physical assets or predominantly knowledge assets, managers can employ the optimal amount of governance mechanism for the predominant asset type, with fewer repercussions in the management of the other assets. In many cases, however, managers must choose the level of relational governance mechanism they use, given the mix of assets required by the alliance's goals, either under-supporting knowledge assets or inefficiently governing physical assets (Hoetker and Mellewigt 2009).

This study builds on the supplier perspective of collaboration. The suppliers perspective is important because the understanding of collaborative activity directly affects the quality of collaboration and overall outcomes. Just as supplier knowledge and satisfaction can improve with capability and governance alignment, it can also deteriorate with non-alignment. Thus, it is advantageous for buyers, to view the collaboration through the supplier's lens. This perspective helps buyers identify supplier needs and brings buyers and suppliers closer to each other. When a buyer provides better information to suppliers, the result will be increased participation of supplier in collaboration. This, in turn, will help buyers to achieve their goals for collaboration.

Although, the study explores the supplier perspective of the collaboration, the practical implication of this study would be beneficial to both suppliers and buyers. For suppliers, the study is important to understand the nature of the relationship between capability and different forms of collaboration. Although, the contractual and relational governance both are important in effectively sharing the resources and information in collaborative arrangement, this study can help the managers at

supplier site to understand the preference of one over another in presence of particular assets and capability. This decision also needs to be understood in the perspective of number of competitors in the market and the position of supplier in the business. Suppliers with higher position in the market will have more power to negotiate the terms and conditions of the agreement with buyer. However, supplier not at top position may be more willing to work out the deal with supplier for mutual benefits.

This study may help the managers at buying organisations in terms of understanding the behaviour of supplier in different combinations of capability and collaboration activities. By understanding the supplier preference over particular form of exchange process in collaboration, buyer will be more open towards that exchange process and can better prepare to deal with the supplier in collaboration. The aim of buyer-supplier collaboration is to work together for mutual benefits and if both parties have better understanding about the relation between capability, inter-firm governance and BSC, they can effectively manage the collaboration.

Moreover, the aerospace industry is a technology-intensive industry and supplier's involvement in collaborative projects is invaluable for the buyer. Understanding the preferences of suppliers about the exchange process, the buyer can effectively utilise the specialised assets of suppliers. The findings in this study can be looked in the context of dyadic relation between buyer and supplier. If a complex supply chain is assumed as a network of multiple buyer-supplier dyadic collaborative arrangements, the practical implications of this study can be carefully extended to the supply chain as a whole.

#### **7.4 Research limitations**

Although, a number of academic and practical contribution have been realised in this study, this section discusses the possible limitations in interpreting the findings of this study.

First of all, limitations of cross sectional studies are also applicable in this research. The relationship between capability, governance and collaboration is discussed based on the experience of the managers at one particular time when the data is

collected. It may be possible that the relationship may change over a period of time. The dynamics of relationship over a period is not considered in this research. A longitudinal data set can be useful in incorporating the development of relationship in this study.

This study is limited to the aerospace industry in the UK region and therefore, findings cannot be generalised to other industries and in different geographical region. The economic and institutional conditions such as market size, legal system in the country, economic development, market uncertainty, nature of competition etc. can change the operating environment in which buyers and suppliers work. This study also did not investigate the possible asymmetry in bargaining power structure in the supply chain members. Due to different goals and asymmetric power positions between buyers and suppliers, one partner can control the governance mechanism and force its decision on other. Developing the particular form of governance mechanism may involve some direct and indirect cost and therefore determining the optimal level can also be influenced by the economic condition of the buyer and supplier. This issue is also not considered in this study.

Survey research is used as the primary method of data collection in this study. Survey research is criticised with the problem of appropriate sample size, response rate etc. and therefore the common limitations of survey research also apply to this study. However, the response rate for this study is at the respectable level normally found in the operations management area. Qualitative research method like case study could have provided the in-depth study of the capability, governance and collaboration phenomenon. In addition, the survey research in this study has used closed questions where there was little freedom to record any specific event or factor which might have more influential effect on the relationship between supplier capability and collaboration type. This could have been avoided by using a mixed method strategy for data collection, which includes both qualitative and quantitative form of data collection techniques. However, mixed mode of data collection is a time consuming process.

Limited theoretical guidance has been available in this area to understand the dynamics of capability and governance mechanism in different types of buyer-supplier collaboration. This study is limited to only three types of capabilities

(R&D, production and support services) and three types of collaboration (IS, CPD and CPS). The list of capabilities and collaboration type in real life is not limited to only the capabilities, governance and collaboration type discussed in this research. Other factors like operating conditions in the industry, product complexity etc. could be influential in deciding the dynamics of the capability-governance-collaboration model. Future research should be developed on the foundation of this study to explore the other potential moderating/mediating variables for the capability-governance-collaboration framework. For example, the sheer size of a project can influence firm's governance choice, which is not considered in this research.

In addition, the multiple mediation model discussed in this study assumes that one mediator variable does not affect other. However, in practice the contractual governance and relational governance mechanisms seem to have some interconnection based on the fact that practitioners argue that either both work parallel or one follows other. In this research, for the analysis purpose both are treated independent to each other and further research could be conducted to test the interrelation between the contractual and relational governance. Even the moderated mediation and mediated moderation models suggested by (Preacher and Hayes 2008a) could be further explored to see the combined results of mediation and moderation effects. Although, the bootstrapping technique adopted in this study, benefits with a number of advantages, it also suffers with some minor limitations (Preacher and Hayes 2008b). The accuracy of bootstrap confidence intervals depends on the number of re-samples and re-sampling is a time consuming process. However, in today's age of fast computers, the processing time can be significantly reduced.

The data limitation could raise some concerns regarding the generalisability of findings of this study. In relation to the sample size of the analysis, of course bigger sample size can give more confidence towards generalising the findings of this study. However, sample size should be seen in the context of the focus of this research, which is limited to only aerospace industry. In addition the information desired in this research requires the responses from senior managers in the small and medium sized firms. Therefore, the sample size is enough to offer insights in

the capability-governance-collaboration relationship in aerospace sector. Data at cross-sector level could give more insight in understanding and comparing the similar relationship in different industries.

### **7.5 Future research direction**

This research has investigated the relationship between capability, governance and buyer-supplier collaboration from the suppliers' perspective and highlighted the importance of alignment between capability and governance mechanism in BSC. There are limited previous literatures available which considered these three components together to provide a holistic view of buyer-supplier collaboration. Therefore, this study provides the foundation for future research in the area of BSC in order to better understand the factors, which affects the collaboration performance.

There is a number of potential ways in which this study can be further extended in future. First of all, in this study only three functional capabilities (R&D, production and support services) are considered for the analysis. The list of capabilities identified in this study is not comprehensive and further research is required to first to identify the key capabilities of suppliers and then investigate the impact of these capabilities on the BSC phenomenon. Future research should explore the nature and characteristics of some of the capabilities like absorptive capability, learning capability, alignment capability, green capability etc., and investigate the relationship with governance and buyer supplier collaboration performance. In addition, the list of buyer – supplier collaboration type is also not complete and therefore, future research is required to understand the different types of collaboration activities buyer and suppliers are engaged in. The multiple combinations of capabilities and collaboration types will develop an interesting area of research to understand the impact of firm specific capabilities on the BSC. In-depth study to explore the supplier's view of different forms of collaboration will be worthwhile to understand the bottom up view of collaboration. This would be helpful to align the collaboration objectives of buyer and supplier in BSC. In future, research thinking also needs to be developed on the firm - boundary specific capabilities and boundary spanning capabilities. The dynamics between boundary specific and boundary spanning capabilities in BSC will be interesting to explore.

Future research could also works towards findings various mediating and moderating variables, which affect the relationship between capability, governance and collaboration. Technological uncertainty in the market and nature of competition could influence the choice of governance mechanism in inter-firm exchange process. Product and process complexity, cost involved in maintaining the formal and informal relationship, negotiation power etc. could also affect the capability, governance and collaboration relationship. Future research should expand on theses themes to understand the various factors, which can play the decisive role in adopting a particular form of governance.

This study only considers the measurement of supplier capabilities at a particular time. However, in real life capabilities evolve over time. The cross sectional nature of the data can limit the understanding of the phenomenon, which changes over time. Future research should incorporate the longitudinal data set to understand the dynamics of the relationship between capabilities, governance and collaboration. In-depth case studies could be useful in understanding the development and changes in capabilities, type of the governance mechanism and type of collaboration between buyer and supplier.

This research highlights the importance of contractual and relational governance in the perspective of BSC and explains that both forms of governance are important in administering the exchange process in BSC. However, the relative effect of contractual and relational varies for multiple combinations of capability and collaboration types. These findings could be further examined for other combinations of capabilities and collaboration relationships. Future work could also be extended to explore the questions like which forms of governance comes first in developing the multiple types of buyer-supplier collaboration? Does inter-firm relationship build on the successful completion of contract or vice versa? Further work should also be conducted to comprehensively understand the inter-relation between contractual and relational governance. Zheng et al. (2008) also argue that different development characteristics of relational and contractual mechanisms suggest that their dynamic interplay does not follow consistent patterns and concludes with suggestions for more longitudinal studies.

This study is limited to the aerospace industry only and therefore similar study in other industries can be conducted in future to identify any particular trend of relationship among capability, governance and collaboration in different industries. The comparative study of different industries such that automobile, retail etc. in terms of exploring the relationship-trend would be interesting to see. Research can also be extended to other geographical regions across the globe in similar industry. Comparative study on the basis of geographical region can be interesting to understand any location, tradition or culture specific factors affecting the capability-governance-collaboration relationship. For example, a culture that is heavily inward-focused could lead to an arrogance that may lead to development of more contractual based governance. In increasing dominance of international collaboration, location of the organisation can make some interesting impact on the capability-governance-collaboration model.

In this study, only the dyadic collaborative arrangement between buyer and supplier is explored. It would be interesting to further see studies, which discuss the supply chain or supply network level collaboration in the similar problem context. Moreover, the data is collected from only one side of the dyadic collaboration i.e. suppliers, which may not be able to give the complete picture of collaboration. Future research should incorporate the perspective of both buyer and supplier to provide the complete picture of capability-governance-collaboration model. This will provide the opportunity to understand the both side of story and then do the comparative analysis. However, this will involve a significant resource commitment in data collection process. Moreover the characteristics of the firm can also affect the nature of relationship between capability, governance and collaboration. The difference between a long established firm and the new entrants in market is not considered in this study. Both types of firms may have different attitude towards collaboration and boundary decisions for governance. For example, new entrants may have lower barriers to integration into product markets. Future research should also build on these themes to understand the firm specific factors in collaboration. Similarly, the type of the firm (manufacturer, service provider and manufacturer-cum-service provider) can have impact on the relation between capability, governance and collaboration type. Future research can explore these issues.



In terms of research framework, a multiple mediation model for the relationship between capability, governance and collaboration is developed and bootstrapping based analysis technique is used in this study. As discussed above, a number of factors related to market uncertainty, competition, firm characteristic, location, culture etc. could affect the relationship between capability, governance and collaboration and make the theoretical framework complex. Different types of capabilities and collaboration can further enhance the complexity of the model. In future, moderated mediation and mediated moderation models could be developed to investigate these complex natures of relationships. Findings of such mediation and moderation effects will be interesting to see in future.

## **7.6 Final remarks**

This study focuses on understanding the relationship between capability, governance and buyer-supplier collaboration from suppliers' perspective. The concept of resource based view of the firm and transaction cost economics are combined to develop the theoretical framework and explain the capability-governance-collaboration model. The study supports the argument that although the capability of the firm is important, inter-firm governance mechanism is equally important to perform in collaboration. The study provides empirical evidence to partially support the complementary nature of contractual and relational governance (i.e. both are needed together). The study also adds support for the ongoing argument of extended resource based view, which emphasises on both the firm's capability and inter-firm relationship to develop sources for sustainable competitive advantage. The findings of this research suggest that practitioners should align governance mechanism with the capabilities firm possess. Bearing in mind the limited empirical research available in combining the capability, governance and collaboration phenomenon, this study is important in paving the way for further comprehensive research in buyer-supplier collaboration. Hopefully, this study will stimulate more research in similar area, not only with dyadic perspectives of buyer and supplier but adopting similar themes at more broader level, such as the supply chain or network level.

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## APPENDIX A: Questionnaire for preliminary research

### ‘Understanding buyer-supplier collaboration in UK aerospace industry’

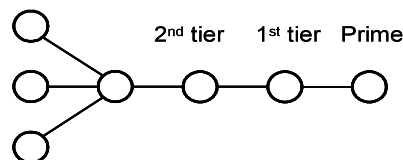
A set of questions for semi-structured interview is developed for preliminary study. Brief interview of about 1 hour at the firm site is conducted to explore the issues related to supply chain collaboration in aerospace industry. Recommended participants are directors, managers or senior managers having the background in strategy development, operations management, product development, supplier development, project management or supply chain management.

#### *Section A: Internal firm focus:*

1. Please briefly describe the nature of your business. What are your core products and services?
2. Describe your most important internal capabilities & resources in the firm (e.g. process technology, R&D, core knowledge, supply & distribution etc). How are they valuable, and to what extent sustainable?
3. Have you seen a shift towards greater demand for supply chain collaboration over past few years or so? If so, what impact has this had on your business?

#### *Section B: External to the firm focus:*

4. Describe your position in the supply chain? (Use figure as guide, but amend if necessary)



5. Please briefly describe your main/primary customers. What are their core products and services? How long are you in business with them?
6. Please briefly describe the most important external/shared resources and capabilities (e.g. physical assets, knowledge, technology, information,

supplier networks etc.) for your business, which you think lie in the inter-firm collaboration. How are they valuable, and to what extent sustainable?

7. Please briefly describe the inter-firm collaborative activities (e.g. R&D, Sharing of Information, and Sharing of resources) involved in your business?
8. Please briefly describe your understanding of the type of inter-firm collaboration in supply chain?
9. How is the supply chain collaboration administered? (Contractual, relational or both)
10. Describe the future direction of supply chain collaboration? What are the most significant challenges and motivation for supply chain collaboration?

## **APPENDIX B: Questionnaire for pre- testing the survey instrument**

The purpose of this study is to understand the relationship between organisational capability and collaboration performance. The purpose of pre-testing the survey instrument is to examine, that the questions and items included in the survey are easily understandable and consistent with the aim of the study. Interviewees are asked to critically review the survey instrument and provide feedback on everything that can negatively affect the answering of questions. They can identify any aspects of the questionnaire that are unclear, confusing, ambiguous and hard to understand etc. The following questions are considered while pilot testing the survey instrument:

1. Are the instructions and the aims of the study clear enough to answer the questions asked in the survey?
2. Are the questions clear and easily understandable?
3. Are there any problems in understanding what kind of answers are expected, or in providing answers to the questions posed?
4. Are the structure (eg. sequence of questions) and design (eg. font size, spacing between sentences etc.) of the questionnaire logical?
5. Is the questionnaire easy to complete? If not what are the things that are unclear or out of respondents' range of knowledge and/or responsibility?
6. Is the language used in the questionnaire free from jargons, slangs and abbreviation? Is the language and terminologies used in the questionnaire appropriate for the target respondents?
7. Is there any question, which the respondent objects to answer?

8. Is the length of the questionnaire appropriate?
9. How long do you take to fill the complete questionnaire?
10. Is each respondent likely to read and answer each question? Can I eliminate some of the questions?
11. Are the items consistent with the questions asked? Can I ask some questions differently for better response?
12. Are there any elements of the questionnaire, which you think should be changed, deleted or modified?
13. Are the questions straightforward to understand?
14. Please provide any suggestion that helps to improve the questionnaire and response rate. Is there anything, which you don't like about the questionnaire?
15. Finally, please provide your overall reaction to the questionnaire. Please try to be specific whenever appropriate.

## APPENDIX C: Survey Cover Letter



### A Survey on Organisational Capability and Collaboration Performance

15<sup>th</sup> January 2010

Dear Sir/Madam,

The University of Bath in collaboration with the **West of England Aerospace Forum (WEAF)** are conducting a study to understand the relationship between organisational capability (i.e. how good you are at doing things) and collaboration performance (i.e. how good you are at working with others). A **summary report** of the findings will be sent to all those involved in the study. This report will be beneficial in maintaining and enhancing your long-term competitiveness.

The questionnaire will take no more than **20 minutes** to complete. Your responses will be treated in the strictest confidence and we will not disclose your personal details to anyone. If you would like to fill the questionnaire online, the web link to do so is <http://www.surveymonkey.com/s/XMXSTJQ>

As a small token of appreciation, every respondent will also be entered in a draw to win **£100 worth of Marks & Spencer shopping vouchers**. Please do not forget to include your email address at the end of your responses so that we can enter you into the draw.

Thank you very much for your support.

Yours sincerely,

A handwritten signature in blue ink, appearing to read "Niraj Kumar", with a horizontal line underneath.

**Niraj Kumar**

Research and Teaching Associate

Information, Decisions and Operations (IDO) Group

If you have any queries related to this study, please do not hesitate to contact me via Telephone (01225 383147) or email ([n.kumar@bath.ac.uk](mailto:n.kumar@bath.ac.uk))



## APPENDIX D: Survey Instrument

### Section A: Background Information

Please indicate your answer to each question by either *writing* in the space provided or *ticking* the most appropriate option.

A1. What are the **core products or services** your organisation provides?

.....

A2. What is the **primary industry** in which your organisation operates? (For example, Aerospace, Automotive etc.)

.....

A3. Please indicate the **type of your organisation**:

- ☐ Manufacturer (eg. Organisations which produce components/finished goods/software etc.)
- ☐ Service provider (eg. Organisations which provide consultancy services, logistics services etc.)
- ☐ Manufacturer-and-service provider

A4. What is the total **number of employees** in your organisation?

- |                                       |                                    |                                    |  |
|---------------------------------------|------------------------------------|------------------------------------|--|
| <input type="checkbox"/> Less than 50 | <input type="checkbox"/> 51 - 100  | <input type="checkbox"/> 101 - 150 | <input type="checkbox"/> 151 - 200     |
| <input type="checkbox"/> 201 - 250    | <input type="checkbox"/> 251 - 300 | <input type="checkbox"/> 301 - 350 | <input type="checkbox"/> more than 350 |

A5. Please indicate the **average sales revenue per annum** of your organisation (either in million US Dollars, GB Pounds or Euros):

☐ US \$ ..... / ☐ GB £ ..... / ☐ Euros € .....

A6. Please indicate your organisation's **average expenditure per annum on research and development activities** (either in million US Dollars, GB Pounds or Euros):

☐ US \$ ..... / ☐ GB £ ..... / ☐ Euros € .....

A7. What is **your job-title** in the organisation (eg. CEO, General Manager, Director, Manager in Supply chain/Operations/ Strategy etc.)?

.....

A8. How long have you been **working** in this organisation?

..... Years & ..... Months

A9. Please provide the **postcode** of your organisation:

.....

## Section B: Your Organisation's Capabilities

In this section, please focus on your organisation's **core skills and capabilities**. Please indicate your answer to each statement by *circling* the most appropriate number.

B1. To what extent do you disagree or agree with the following statements regarding your organisation's **Research and Development (R&D) capability**?

	<i>Strongly disagree</i>							<i>Strongly agree</i>
We consistently spend on research and development activities.	1	2	3	4	5	6	7	
We have consistent research outputs in terms of patents or research papers.	1	2	3	4	5	6	7	
We have proven ability to link research and development activities with the market requirement.	1	2	3	4	5	6	7	
We have improved our market share due to our research output.	1	2	3	4	5	6	7	
We have proven ability to apply our research to enhance the performance of product/services we offer.	1	2	3	4	5	6	7	
We have proven ability to develop new products/services.	1	2	3	4	5	6	7	

B2. To what extent do you disagree or agree with the following statements regarding your organisation's ability to provide **support services** (eg. technical support, maintenance etc.) to the buyer?

	<i>Strongly disagree</i>							<i>Strongly agree</i>
We consistently provide customised support services according to individual buyer's requirements.	1	2	3	4	5	6	7	
We have proven ability to reduce waiting time for support services.	1	2	3	4	5	6	7	
We have proven ability to provide support services at the promised time.	1	2	3	4	5	6	7	
We have proven ability to provide wide range of services like maintenance, training to buyer's personnel etc.	1	2	3	4	5	6	7	
We have proven ability to deal with urgent support requests from buyer, such that in-process product failure etc.	1	2	3	4	5	6	7	
We have proven ability to consistently provide quality support services.	1	2	3	4	5	6	7	

B3. To what extent do you disagree or agree with the following statements regarding your organisation's **ability to produce** goods (e.g. components, products etc.) effectively?

	<i>Strongly disagree</i>					<i>Strongly agree</i>	
We consistently offer products according to buyer’s specifications.	1	2	3	4	5	6	7
We have proven ability to reduce production cycle time.	1	2	3	4	5	6	7
We have proven ability to deliver products on time.	1	2	3	4	5	6	7
We have proven ability to cope with uncertain demand.	1	2	3	4	5	6	7
We have low rate of product failure due to quality problems.	1	2	3	4	5	6	7
We have proven ability to reduce production cost through continuous improvement.	1	2	3	4	5	6	7

B4. To what extent do you disagree or agree with the following statements regarding your organisation's **ability to recognise the value of external knowledge** and apply it to commercial ends?

	<i>Strongly disagree</i>					<i>Strongly agree</i>	
We have strong ability of learning from partners.	1	2	3	4	5	6	7
We have proven ability to integrate external information and transform it into organisation-embedded knowledge.	1	2	3	4	5	6	7
We have strong ability to analyse new technology and share relevant information across the organisation.	1	2	3	4	5	6	7
We have strong ability to recognise complementary knowledge and assimilate it with existing internal knowledge.	1	2	3	4	5	6	7
We have proven ability to replicate new knowledge gained from external sources.	1	2	3	4	5	6	7

B5. Please indicate to what extent, the following organisational capabilities are **important** in your industry to maintain the competitive advantage?

	<i>Not at all</i>				<i>A very great extent</i>			
Technological capability.	1	2	3	4	5	6	7	
Ability to provide after-sales support services (eg. Maintenance, Training buyer's personnel etc.).	1	2	3	4	5	6	7	
Ability to produce goods (eg. components, products, software etc.)	1	2	3	4	5	6	7	
Ability to provide services (eg. consultancy services, logistics services etc.).	1	2	3	4	5	6	7	
Ability to recognize the value of external knowledge and apply it to commercial ends.	1	2	3	4	5	6	7	

### Section C: Operating Environment in Your Industry

In this section, please provide your general perceptions about the **operating environment** in which your organisation operates. Please indicate your answer to each statement by *circling* the most appropriate number.

C1. To what extent do you disagree or agree with the following statements regarding the **nature of competition** in your industry?

	<i>Strongly disagree</i>							<i>Strongly agree</i>
We face fierce competition in the market.	1	2	3	4	5	6	7	
It is very tough to win in this marketplace.	1	2	3	4	5	6	7	
It is hard to predict the future market condition.	1	2	3	4	5	6	7	
We need to frequently improve our product/services to keep up with competitors.	1	2	3	4	5	6	7	
It is quite easy to predict competitors' behaviour and action in this marketplace.	1	2	3	4	5	6	7	

C2. To what extent do you disagree or agree with the following statements which describe the **technological uncertainty** in the industry?

	<i>Strongly disagree</i>							<i>Strongly agree</i>
The technology is changing rapidly in this industry.	1	2	3	4	5	6	7	
Technological breakthrough is required to develop new products in this market.	1	2	3	4	5	6	7	
It is quite difficult to predict where the technology in this marketplace will be in next 5 years.	1	2	3	4	5	6	7	
Technological developments in this market place are rather minor.	1	2	3	4	5	6	7	

### Section D: Collaboration with the Key Strategic Buyer

In this section, please focus your answers on one of the **key strategic buyers** with whom you have been involved in collaborative activities such as product/service development, knowledge exchange etc. Please indicate your answer to each question by either *writing* in the space provided or *circling* the most appropriate number.

D1. Please indicate the approximate **duration of working relationship** with this buyer:

..... Years & ..... Months

D2. Please indicate the approximate **duration of current contract** with this buyer:

..... Years & ..... Months

D3. Please indicate the approximate **percentage of total annual sales** provided by this buyer:

..... %

D4. What is the **average duration of contracts** you have signed with this buyer in the past?

- ☐ No contract at all
 ☐ Less than 6 months
 ☐ 6 months – 1 year  
☐ 1-2 years
 ☐ 2-5 years
 ☐ 5-10 years
 ☐ more than 10 years

D5. To what extent of detailed **formal written agreements/contracts** your organisation has signed with this buyer?

	<i>Not at all</i>				<i>A very great extent</i>		
	1	2	3	4	5	6	7
We outline the roles and responsibilities of each party in collaboration in the formal written agreement.							
We include the expected collaborative outcomes in the agreement while designing the contract.							
We specify the procedures in the contract for monitoring the development in collaborative activities.							
We outline the procedures in the contract for handling the complaints and disputes in collaborative activities.							
We include the guidelines in the agreement regarding non - compliance and premature termination of the contract.							
We outline the warranty policies in the contract.							

D6. To what extent do the following statements describe your **organisation's relationship** with this buyer?

	<i>Not at all</i>				<i>A very great extent</i>		
	1	2	3	4	5	6	7
We actively involve in close personal interaction at multiple levels with the buying organisation.							
We actively engage in informal communication with the buyer to work out the new deal.							
We are willing to share important private information with the buyer, if required beyond the formal agreement.							
We work out the collaborative action plan based on buyer's commitment.							
We would rather make adjustments to cope with unexpected circumstances than holding each other to the original agreement.							
We are open to modify the agreement in transparent manner if unexpected events occur.							
We make an effort to help our buyer during emergencies.							
We are flexible in responding to buyer requests for any change in formal agreement.							

D7. To what extent does your **organisation prefer** to sign a formal written agreement rather than building a relationship with this buyer?

<i>Not at all</i>						<i>A very great extent</i>
1	2	3	4	5	6	7

### Section E: Collaboration Performance

In this section, Please indicate your answer to each statement by *circling* the most appropriate number.

E1. To what extent do you disagree or agree with the following statements regarding the **degree of information sharing** with this buyer?

	<i>Strongly disagree</i>					<i>Strongly agree</i>	
We regularly share product/service related information.	1	2	3	4	5	6	7
We regularly exchange price and market related information.	1	2	3	4	5	6	7
We regularly share process related information.	1	2	3	4	5	6	7
We regularly exchange forecasting related information.	1	2	3	4	5	6	7
We seldom exchange delivery scheduling information.	1	2	3	4	5	6	7

E2. To what extent do you disagree or agree with the following statements regarding the **degree of collaborative product/service development** with this buyer?

	<i>Strongly disagree</i>					<i>Strongly agree</i>	
We share our skills to develop new products/services.	1	2	3	4	5	6	7
We work together from the early stage of project/concept development.	1	2	3	4	5	6	7
We share the cost of new product/service development.	1	2	3	4	5	6	7
We collaboratively take the risk to develop new products/services	1	2	3	4	5	6	7
We seldom work together on new product/service development.	1	2	3	4	5	6	7

E3. To what extent do you disagree or agree with the following statements regarding the **degree of collaborative problem solving** with this buyer?

	<i>Strongly disagree</i>					<i>Strongly agree</i>	
We work together to solve product/service cost related problems.	1	2	3	4	5	6	7
We collaboratively solve quality related problems.	1	2	3	4	5	6	7
We collaboratively solve delivery schedule related problems.	1	2	3	4	5	6	7
We work together on problems related to uncertain demand pattern.	1	2	3	4	5	6	7
We seldom work together on product/service design problems.	1	2	3	4	5	6	7

### Section F: Final Section

If you have any other comments about this study, please feel free to use the space below.

If you would like to receive a **summary of this study**, and also like to take part in the draw for a chance to **win £100 M&S shopping coupons**. Please don't forget to include your **email** address here: Email: .....

***Thank you!***

## APPENDIX E: Research publications

1. **Niraj Kumar**, Mickey Howard, Mike Lewis and Sinéad Carey, Exploring the influence of contractual and relational governance on the relationship between capability and collaboration, *Proceedings of 18<sup>th</sup> European Operations Management Association (EurOMA'11) Annual Conference, Cambridge, UK, July 3-6, 2011.*
2. **Niraj Kumar**, Mickey Howard, Sinéad Carey and Michael Lewis, Relationship between supplier's capabilities and collaboration type: A conceptual framework, *Proceedings of Decision Sciences Institute 41<sup>st</sup> Annual Meeting, San Diego, USA, Nov 20 – 23, 2010.*
3. **Niraj Kumar**, Mickey Howard, Sinéad Carey and Michael Lewis, Exploring the impact of technological capability on inter-firm collaboration in UK aerospace industry, *Proceedings of POMS 21<sup>st</sup> Annual Conference, Vancouver, Canada, May 7 – 10, 2010.*
4. **Niraj Kumar**, Mickey Howard and Michael Lewis, Resource Based Strategy in the Context of Supply Chain: Evolution and Beyond, *Proceedings of 15<sup>th</sup> European Operations Management Association (EurOMA'08) Annual Conference, Groningen, The Netherlands, June 15-18, 2008.*